Exhibit 8

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ERICSSON INC.
NOKIA OF AMERICA CORPORATION
Petitioners,

v.

XR COMMUNICATIONS LLC
Patent Owner.

U.S. PATENT NO. 7,177,369
Title: MULTIPATH COMMUNICATION METHODS AND APPARATUSES

Inter Partes Review No.: IPR2024-00314

PETITION FOR *INTER PARTES* REVIEW OF U.S. PAT. NO. 7,177,369

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1004	U.S. Pat. No. 6,252,914 ("Yamamoto")
1005	Cheong Yui Wong, R. S. Cheng, K. B. Lataief and R. D. Murch, "Multiuser OFDM with adaptive subcarrier, bit, and power allocation," in IEEE Journal on Selected Areas in Communications, vol. 17, no. 10, pp. 1747-1758, Oct. 1999, doi: 10.1109/49.793310 ("*Wong*")
1006	H. Minn and V. K. Bhargava, "An investigation into time-domain approach for OFDM channel estimation," in IEEE Transactions on Broadcasting, vol. 46, no. 4, pp. 240-248, Dec. 2000, doi: 10.1109/11.898744 ("*Minn*")
1007	Che-Shen Yeh and Yinyi Lin, "Channel estimation using pilot tones in OFDM systems," in IEEE Transactions on Broadcasting, vol. 45, no. 4, pp. 400-409, Dec. 1999, doi: 10.1109/11.825535 ("*Yeh*")
1008	J. Heiskala and J. Terry, "OFDM Wireless LANs: A Theoretical and Practical Guide," ISBN: 0672321572, Sams Publishing ("Heiskala") (EX-1008) (2001)
1009	U.S. Pat. No. 6,594,318 ("Sindhushayaha")
1010	H. Lehne et. al., "An Overview of Smart Antenna Technology For Mobile Communications Systems," IEEE Communications Surveys, http://www.comsoc.org/pubs/surveys • Fourth Quarter 1999, vol. 2 no. 4 (1999).
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1014	G. J. Foschini and M. J. Gans, "On limits of wireless communications in a fading environment when using multiple antennas," Wireless Personal Communications 6, pp. 311–335, 1998.

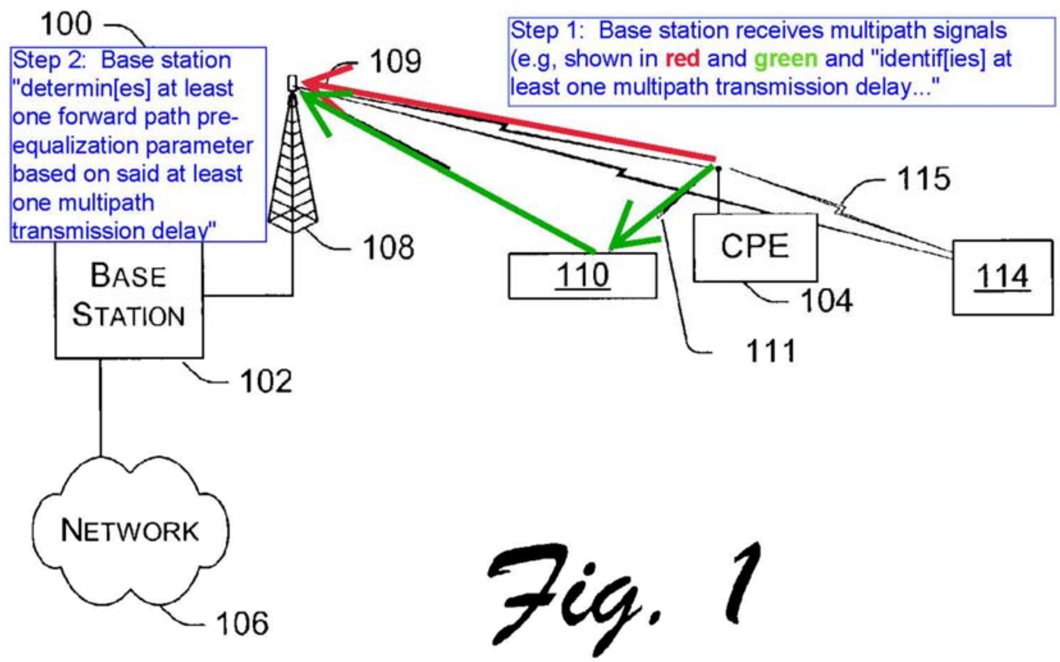
I. INTRODUCTION

Pursuant to 35 U.S.C. §§ 311 *et seq*. and 37 C.F.R. §§ 42.1 *et seq*., Ericsson Inc. and Nokia of America Corporation (collectively "Petitioners") hereby petition for an *inter partes* review of U.S. Patent No. 7,177,369 (the "'369 Patent"). Petitioners respectfully submit that claims 1-7, 9-10, 12-14, 15, 19, 21, 28, 32-33, 35-37, and 41 (the "Challenged Claims") of the '369 Patent are unpatentable under 35 U.S.C. §103 in view of the prior art herein – none of which was considered during prosecution.

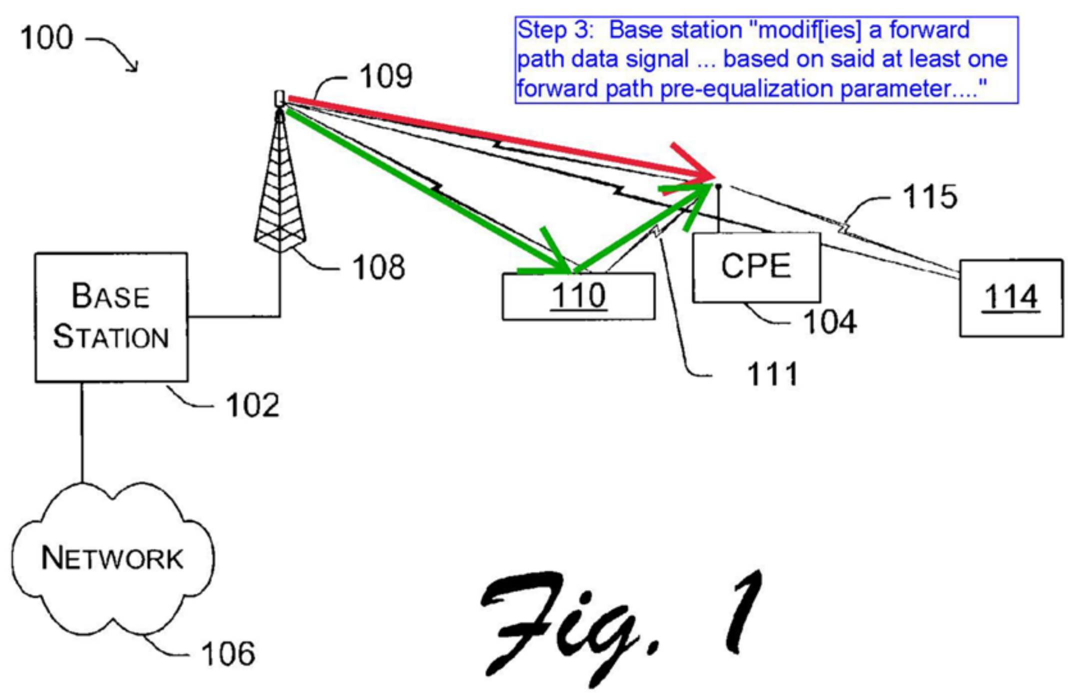
II. OVERVIEW

The Challenged Claims are directed to techniques for improving wireless communications between a base station ("BS") and a remote device. Specifically, the BS measures channel characteristics of the "reverse channel" of transmissions from a remote device to a BS. Based on those channel characteristics, the BS modifies aspects of the "forward channel" transmissions from the BS to the remote device. The concept of measuring the "reverse channel" to estimate the "forward channel" is known as "reciprocity" which the '369 Patent acknowledges was "well-known" prior to the '369 Patent. EX-1001, 7:22-33.

The following series of annotated Figures 1 graphically depicts Challenged Claim 1. First, the BS receives multipath signals and calculates a "parameter."



EX-1001, Fig. 1.[1] The BS then modifies the BS-to-remote transmissions based on the calculated parameter:



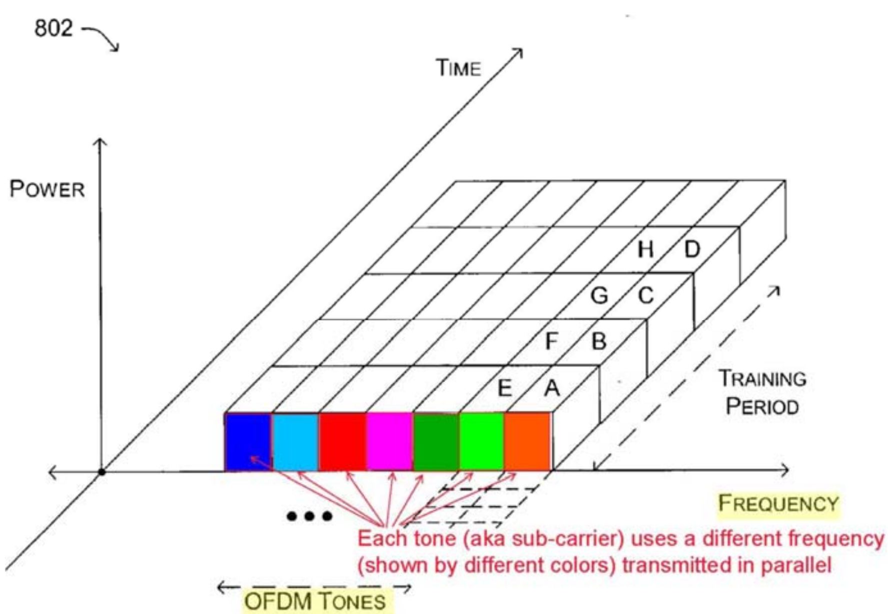
[1] Unless otherwise noted, all emphases and annotations herein have been added.

The claimed steps of using a reverse channel estimation to adjust forward transmissions was well-known prior to the '369 Patent. During prosecution, the (then-pending) claims were rejected as anticipated. Section V.B, *infra*. The applicant amended the claims to require a specific modification:

> modifying a forward data path signal … where said modifying includes selectively setting different transmission power levels for at least two Orthogonal Frequency Division Multiplexing (OFDM) tones in said forward path data signal."

EX-1002, 0044-0064.

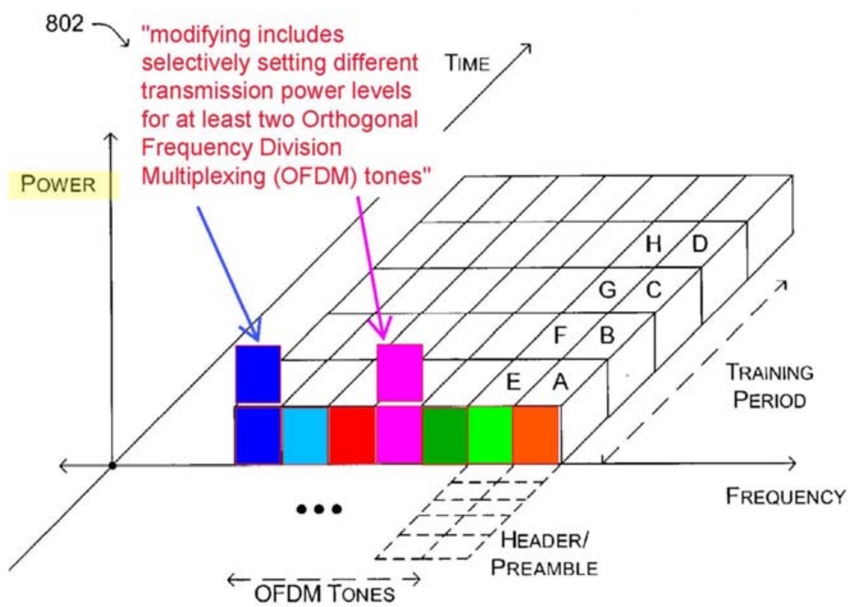
In OFDM, the to-be-transmitted data stream is divided into multiple individual data streams that are transmitted in parallel on different frequencies at a particular power. Annotated Fig. 8 of the '369 Patent depicts OFDM transmission.



EX-1001, Fig. 8. Each parallel "lane" is called an OFDM "tone" or "subcarrier" with each tone/subcarrier transmitted on its own distinct frequency. *E.g.*, EX-

1001, 3:66-4:1 ("OFDM operates by coding a series of bits into a set of modulated orthogonal sub-carriers"); 9:63-10:13.

The claim amendment requires "selectively setting different transmission power levels for at least two ... tones…." EX-1002, 0044. This is depicted below showing the "blue" and "purple" subcarriers / tones having modified "power" level (shown on the vertical axis).



EX-1001, Fig. 8. The applicant's amendment overcame the prior art during prosecution. This "selectively setting … power levels" amendment was the <u>sole argument for patentability for **any** Challenged Claim</u>. Section V.B, *infra*.

The primary reference cited herein (Wong, EX-1005) explicitly focuses on precisely the concept allegedly missing from the cited prior art during prosecution: modifying different power levels for OFDM subcarriers (tones) being transmitted in the downlink direction. Wong's "Conclusion" expressly summarizes this

concept:

> In this paper, we considered **OFDM transmission** in a multiuser environment and formulated the problem of minimizing the overall transmit power by **adaptively assigning** subcarriers to the users along with the number of bits and **power level to each subcarrier**.

EX-1005, 1756-57. Wong's "adaptively assigning … power levels to each subcarrier" is precisely the "selectively setting … power levels" that was alleged to be missing from prior art during prosecution.

As in the (later) '369 Patent, Wong bases the OFDM power level modifications on the well-known reciprocity concept. Wong recites that its power modification is based on the channel characteristics of the reverse channel transmission (from mobile to base station).

> "[T]he base station (BS) can estimate the instantaneous **channel characteristics of all the BS-to-mobile links** based on the received uplink transmissions. The multiuser **subcarrier, bit, and power allocation can then be used**."

EX-1005, 1748. *See also* EX-1005, 1747 ("Assuming **knowledge of the instantaneous channel gains** for all users, we propose a multiuser OFDM subcarrier, bit, and power allocation algorithm …. This is done by assigning each user a set of subcarriers and by determining the number of bits and **the transmit power level for each subcarrier**.")

Thus, Wong itself renders obvious the Challenged Claims as detailed in

Ground 1, *infra*. Alternatively, Petitioners have included a secondary reference (Minn, EX-1006) that expressly discloses the type of channel information (multipath delay) recited in the Challenged Claims.

Finally, as detailed in Ground 2, the Challenged Claims include a series of dependent claims that recite well-known characteristics of base stations that are unrelated to the invention of the '369 claims. *E.g.*, claim 15 (reciting that there is "at least one" antenna associated with a base station). These dependent claims did not impart patentability during prosecution (Section V.B, *infra*) nor do they do so here. Out of an abundance of caution, Petitioners include a separate reference, Lehne (EX-1010), that provides extensive details on the known "smart antenna" technology available to base stations in 1999 – well before the 2001 priority date of the Challenged Claims.

The Challenged Claims recite a known principle (reciprocity) applied to a known technique for using reciprocity (adjusting forward channel transmissions based on measurements of the reverse channel). Wong describes precisely the type of forward channel modification recited in the claims – which was the only basis of patentability during prosecution. Petitioners respectfully request that the Board institute IPR and cancel the Challenged Claims.

III. GROUNDS FOR STANDING (37 C.F.R. § 42.104(A))

Petitioners certify that the '369 Patent is available for IPR and that

Petitioners are not barred or estopped from requesting an IPR of the Challenged Claims on the grounds identified herein. 37 C.F.R. § 42.104(a).

IV. REASONS FOR THE REQUESTED RELIEF

As explained below and in the attached Declaration of Petitioners' Expert (EX-1003), the Challenged Claim were obvious over the prior art to a person of ordinary skill in the art ("POSITA") at the time of the invention.

V. BACKGROUND

A. Summary of the '369 Patent

As shown in the Introduction, the '369 Patent claims the admittedly well-known concept of reciprocity combined with an (also well-known) concept of using reciprocity to modify the power levels of forward path OFDM subcarriers.

B. Prosecution History

The '369 Patent issued from U.S. Pat. App. No. 10/131,864 filed April 25, 2002 claiming priority to U.S. Provisional Pat. App. No. 60/287,163 ("'163 Provisional") filed on April 27, 2001.

During prosecution, the Examiner determined that U.S. Pat. No. 6,252,914 ("Yamamoto") (EX-1004) either anticipated or rendered obvious the pending claims corresponding to the Challenged Claims. EX-1002, 0069-0077.

In response, the applicant apparently amended the claims. EX-1002, 0043-0064). This Amendment was dated the day after the Examiner's rejections and does not mention the rejections. Also, the record shows a "Teleconference August

28, 2006 with Examiner" but does not document the discussion. EX-1002, 0043. Despite this incomplete record, the applicant was allowed to amend the claims to recite "<u>where said modifying includes selectively setting different transmission power levels for at least two Orthogonal Frequency Division Multiplexing (OFDM) tones in said forward path data signal.</u>" EX-1002, 0044. The Examiner allowed the claims based on this Amendment. EX-1002, 0033. The underlined passages reflects the only distinction over the prosecution prior art for the Challenged Claims.

C. The '369 Claims Are Not Entitled To The Filing Date Of The Provisional.

The Patent Owner ("PO") declared that the Challenged Claims' earliest priority date is the '163 Provisional application filing date. EX-1013, 0007. The prior art herein predates the '163 Provisional. Thus, the Board does not need to consider whether the Challenged Claims are entitled to the '163 Provisional date unless PO raises a cognizable date challenge.

However, the '163 Provisional does not support the Challenged Claims. Claim 1 requires "determining [a] parameter" that is "based on" a transmission delay. Then, claim 1 requires "modifying a forward path data signal … based on … [the] parameter … where said modifying includes selectively setting different transmission power levels for at least two Orthogonal Frequency Division Multiplexing (OFDM) tones…." The '163 Provisional does not describe setting

OFDM tone power levels “based on” a “parameter” that is “based on” a transmission delay.

The ‘163 Provisional describes adjusting OFDM power levels on EX-1011, 0054-0055. This passage describes “the determination of a worst case path loss over the OFDM tones, and the use of the highest allowed power spectral density for that sub-channel, then reducing the PSD for other tones….” EX-1011, 0054. The passage then states “The determination of the necessary PSD … is determined by a path loss estimation and the knowledge of the reverse link power level transmitted on the reverse link…” EX-1011, 0054. The ‘163 Provisional discloses only that the information used to adjust the PSD (tones) is the “reverse link power level” and the “path loss measurement is made at the BS.” EX-1011, 0055.

“Path loss” measures power, not “time-delay” as the claims recite. The ‘163 Provisional describes comparing the “path loss” against the “knowledge of the reverse link <u>power level</u> transmitted on the reverse link.” EX-1011, 0054. Thus, this passage describes modifications based on measured reverse power loss, not time delay as claimed.

D. Claim Construction

Petitioners propose that each claim term be given its plain and ordinary meaning herein. The prior art herein meets each claim limitation under any reasonable construction.

E. Person of Ordinary Skill in the Art

With respect to the '369 Patent, a POSITA in April 2001 would have been familiar with wireless communications networks, equipment and integrated circuit chips, and would have had at least a working knowledge of the design of physical layer signal processing for Orthogonal Frequency Division Multiplexing (OFDM) wireless communications including the use of multiple antennas. A POSITA would have had at least a Bachelor's degree in Electrical Engineering or an equivalent field, and at least two years of work experience in developing OFDM-based wireless communications. Alternatively, a POSITA would have had a more advanced degree, such as a Master's degree in Electrical Engineering or an equivalent field, combined with at least one year of work experience in developing OFDM-based wireless communications. EX-1003, ¶¶22-27.

F. State of the Art

The following section describes the relevant state of the art as of the priority date. The prior art references, and the discussions of what was known to a POSITA, provide the factual support for the general description of the state of the art, assist in understanding how a POSITA understood the prior art, and provide the motivation to modify or combine the teachings of references.

1. Channel Reciprocity Was Well-Known

In a wireless communication system, reciprocity is the concept that the transmission channels between two devices may exhibit the same characteristics

for transmissions in each direction. For example, when a base station is transmitting to, and receiving from, a mobile device, reciprocity reflects that the environmental conditions will impact the transmissions similarly in each direction.

Reciprocity was “well-known” long prior to the ‘369 Patent. EX-1001, 7:22-34. Indeed, the ‘369 Patent “assumed” that the forward and reverse channels are reciprocal and relied upon “[k]nowing that the channel is essentially reciprocal….”. EX-1001, 10:67-11:2, 12:62-64.

The prior art cited herein also reflects this well-known reciprocity concept. For example, the primary reference (Wong) modifies its forward transmission (base station to mobile device) based on measurements of the “channel characteristics of all the BS-to-mobile links based on the received uplink transmissions.” EX-1005, 1748; EX-1003, ¶446. Similarly, the Minn secondary reference also uses reverse channel condition to allow for forward channel “adaptive modulation and power allocation across the subcarriers according to the channel conditions.” EX-1006, 240.

During prosecution, the Examiner noted that the cited prior art (Yamamoto) taught reciprocity, albeit in different terminology. EX-1002, 0071 (rejection of claim 12). Yamamoto characterized this concept as the measuring the “propagation characteristic of a propagation path” and then using the “inverse characteristic of the propagation path.” EX-1004, 2:39-3:11.

2. Channel Measurements in Time and Frequency Domains

As with reciprocity, the '369 Patent relies upon methods of measuring channel information that were all widely known and used prior to the '369 Patent. The '369 Patent uses, but does not add to, this known technology.

As Dr. Negus explains in detail, to measure the channel conditions (for example, to use for reciprocity), a POSITA knew that such measurements could be made in either the time domain or the frequency domain. EX-1003, ¶¶300-305. The techniques for measure in time domain were widely known and used prior to the '369 Patent. EX-1003, ¶¶306-308. Dr. Negus details several references explaining the various forms of measurements. EX-1003, ¶¶307, 167-176, 154, 188-190, 213-216.

Moreover, as the '369 Patent acknowledges, conversions from time-domain measurements to frequency-domain measurements were also well-known. Such conversions use the well-known Fast Fourier Transform ("FFT") operation and its inverse IFFT operations. EX-1001, 14:56-59 (FFTs convert these time domain signals… into corresponding frequency domain signals), 15:1-2 ("IFFTs … convert the [frequency] signals into corresponding time domain … signals"). The '369 Patent did not add to the FFT/IFFT knowledge and merely used these mathematical operations to perform known conversions between time and frequency domains. EX-1003, ¶302.

VI. IDENTIFICATION OF CHALLENGES

A. Challenged Claims

This Petition challenges claims 1-7, 9-10, 12-15, 19, 21, 28, 32-33, 35-37, 41 of the '369 Patent.

B. Statutory Grounds for Challenges

The Challenges are detailed below and summarized as follows:

Ground	Claims	Basis	Reference
1	1-7, 9-10, 12-15 and 41	§ 103	Wong, alone or in combination with Minn
2	15, 19, 21, 28, 32-33 and 35-37	§ 103	Wong, alone or in combination with Minn, in further view of Lehne

None of the references cited herein were considered during prosecution. Furthermore, the public availability of each reference is established in EX-1012 (Declaration of Dr. Ingrid Hsieh-Yee).

Ground 1:

Cheong Yui Wong, *et al*, "Multiuser OFDM with adaptive subcarrier, bit, and power allocation," IEEE Journal on Selected Areas in Communications, vol. 17, no. 10, pp. 1747-1758, Oct. 1999 ("*Wong*") (EX-1005) was publicly available no later than October 1999 and qualifies as prior art under §102(a)(b). EX-1012, ¶¶29-46.

H. Minn and V. K. Bhargava, "An investigation into time-domain approach for OFDM channel estimation," IEEE Transactions on Broadcasting, vol. 46, no. 4,

pp. 240-248, Dec. 2000 ("*Minn*") (EX-1007) was publicly available no later than February 7, 2001 and qualifies as prior art under §102(a). EX-1012, ¶¶47-63.

Ground 2:

The references cited in Ground 1 in further view of:

H. Lehne et. al., "An Overview of Smart Antenna Technology For Mobile Communications Systems," IEEE Communications Surveys, http://www.comsoc.org/pubs/surveys, Fourth Quarter 1999, vol. 2 no. 4 (1999) ("Lehne")(EX-1010) was publicly available no later than August 18, 1999 and qualifies as prior art under §102(a)(b). EX-1012, EX-1012, ¶¶82-93

The following references reflect the State of the Art as discussed below.

Che-Shen Yeh and Yinyi Lin, "Channel estimation using pilot tones in OFDM systems," IEEE Transactions on Broadcasting, vol. 45, no. 4, pp. 400-409, Dec. 1999 ("*Yeh*") (EX-1007) was publicly available no later than February 2000 and qualifies as prior art under §102(a)(b). EX-1012, ¶¶64-81.

J. Heiskala and J. Terry, "OFDM Wireless LANs: A Theoretical and Practical Guide," ISBN: 0672321572, Sams Publishing ("Heiskala") (EX-1008) (2001) was published in a "First Printing: Dec. 2001." Thus, Heiskala is either contemporaneous art to the '369 Patent or may qualify as prior art to the '369 Patent at least under § 102(a).

G. J. Foschini and M. J. Gans, "*On limits of wireless communications in a*

fading environment when using multiple antennas," Wireless Personal Communications 6, pp. 311–335, 1998. Foschini is prior art under at least §§ 102(a) and (b).

VII. IDENTIFICATION OF HOW THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Ground 1: Claims 1-7, 9-10, 12-15 and 41 are unpatentable over Wong alone or in combination with Minn.

Ground 1 is that Wong alone, or in combination with Minn, renders the identified claims obvious. Minn explains how a POSITA would understand Wong's discussion of using reciprocity to characterize the reverse channels.

1. Overview of Wong

Wong teaches an OFDM system in which a BS transmits data to mobile devices (a "forward" link) and receives data from mobile devices (a "reverse" link). EX-1003, ¶¶113-147. "In such a system, the base station (BS) can estimate the instantaneous channel characteristics of all the BS-to-mobile links based on the received uplink transmissions." EX-1005, 1748.

Using the reverse "channel characteristics," Wong's BS modifies the forward link transmissions (to the mobile devices) by modifying the power levels for different OFDM tones (also known as "subcarriers"). Wong teaches that this power modification is "done by assigning each user a set of subcarriers and by determining the number of bits and <u>the transmit power level for each subcarrier</u>." EX-1005, 1747 (Abstract). Wong's system "adaptively assign[s] subcarriers to the users along with the number of bits and <u>power level to each subcarrier</u>." EX-1005, 1757.

Wong addresses a "major problem" resulting from multipath. "One of the

main requirements on the modulation technique is the ability to combat intersymbol interference (ISI), a major problem in wideband transmission over multipath fading channels." Furthermore, Wong teaches that "[m]ulticarrier modulation techniques, including orthogonal frequency division multiplex (OFDM) … are among the more promising solutions to this problem." EX-1005, 1747.

Wong acknowledges that the solution of modifying transmit power levels was known in the prior art even before Wong. Wong concludes from survey of prior papers that "[a]s <u>different subcarriers experience different fades</u> …, the <u>transmit power levels must be changed accordingly.</u>" EX-1005 at 1747.

Wong's Title is "Multiuser OFDM with <u>Adaptive</u> Subcarrier, Bit, and <u>Power Allocation</u>." EX-1005 at 1747. Wong presents a detailed mathematical analysis of a multiuser OFDM system and the principles underlying the proposed approach of dynamically (and adaptively) modifying various transmission parameters including, specifically, the power assigned to each OFDM subcarrier (tone). EX-1005 at 1748-1756. Wong then provides a detailed "system model" for modifying the OFDM power levels for subcarriers (tones). EX-1005, Fig. 1, 1748-49.

Below is an annotated version of Wong's Fig. 1 identifying the components that implement each aspect of Challenged Claim 1.

Example of "identifying at least one multipath transmission [*channel condition*] within a reverse path data signal received from a receiving device"

and "determining at least one forward path pre-equalization parameter based on said at least one transmission [*channel condition*]"

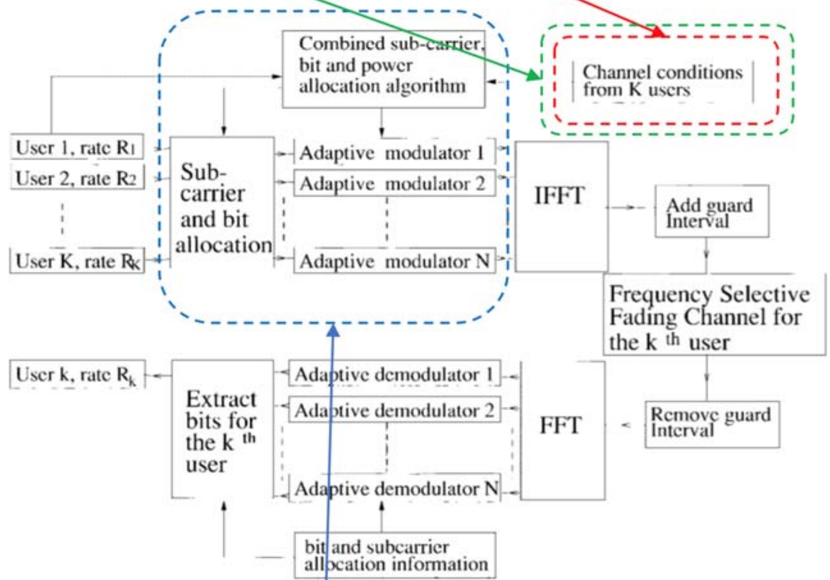


Fig. 1. Block diagram of a multiuser OFDM system with subcarrier, bit, and power allocation.

Example of "modifying a forward path data signal that is to be transmitted to the receiving device based on said at least one forward path pre-equalization parameter, where said modifying includes selectively setting different transmission power levels for at least two Orthogonal Frequency Division Multiplexing (OFDM) tones in said forward path data signal"

EX-1005, Fig. 1. The "channel conditions from K users" correspond to using the reverse path transmissions to calculate a forward path pre-equalization parameter.

The components in blue including the "combined sub-carrier bit and power allocation algorithm" modify the power levels of the OFDM subcarriers / tones based upon the "channel information" from the reverse link. Wong summarizes Wong's Fig. 1 (above) with a passage that succinctly invalidates Challenged Claim

1:

> Using the channel information, the transmitter applies the combined subcarrier, bit, and power allocation algorithm to assign different subcarriers to different users and the number of bits/OFDM symbol to be transmitted on each subcarrier. Depending on the number of bits assigned **to a subcarrier**, the adaptive modulator will use a corresponding modulation scheme, and **the transmit power level will be adjusted** according to the combined subcarrier, bit, and power allocation algorithm.

EX-1005 at 1748.

Wong then presents the details of the iterative allocation algorithm that uses the channel conditions (measured from the reverse channel) to balance the needs of all of the users attached to the base station. Based on this algorithm, Wong's system then allocates (modifies) power levels for each OFDM subcarrier for the downlink transmissions. EX-1005 at 1549-1556.

2. Overview of Minn

Minn is an IEEE paper that presents "An Investigation into Time-Domain Approach for OFDM Channel Estimation." EX-1006, 240 (Title); EX-1003, ¶¶148-179. Minn provides specific details of: (1) identifying multipath transmission delays in an OFDM wireless signal received; and (2) estimating the channel conditions to determine a parameter to be used to adjust OFDM data transmissions. A usage of Minn's time-delay channel condition estimation is

"power allocation across the [OFDM] subcarriers according to the channel conditions." EX-1006, 240.

Thus, Wong and Minn fit together like a hand-in-glove. Wong teaches how modify OFDM power levels based on channel information. Minn teaches a specific form of calculation channel information to use for modifying OFDM "power allocation across [] subcarriers."

3. Detailed Application of Wong in combination with Minn

a. <u>Claim 1</u>

[1.0] A method comprising: identifying at least one multipath transmission delay within a reverse path data signal received from a receiving device:

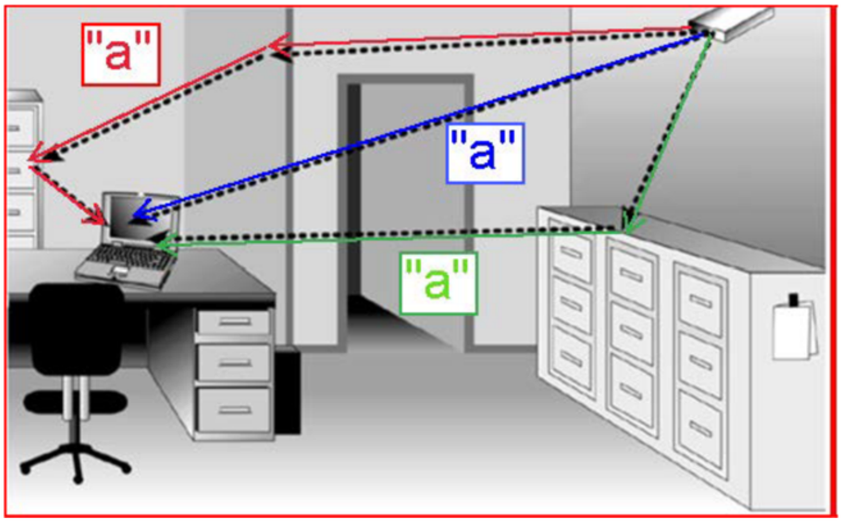
[1.1] determining at least one forward path pre-equalization parameter based on said at least one transmission delay; and;

Wong, alone or in combination with Minn, discloses[2] these elements. EX-1003, ¶¶269-359. Elements 1.0 and 1.1 recite the well-known "reciprocity" concept discussed *supra* in the Introduction and Section V.F.1. The BS measures "channel information" about the "reverse" channel. The BS then uses this "channel information" to calculate one or more parameters to adjust transmissions from the BS to the device on the "forward" channel. The '369 Patent admits

[2] As used throughout this Petition, "discloses" encompasses what a reference would teach, suggest, or render obvious to a POSITA.

reciprocity is well-known prior to the '369 Patent. EX-1001, 7:22-34.

The '369 claims recite a particular form of reverse "channel information" – a "multipath transmission delay." "Multipath" recognizes the concept of multiple propagation paths between transmitter and receiver due to scattering, reflections and/or diffraction with physical objects in the vicinity of the transmitter and/or receiver as visually depicted below.



EX-1003, ¶¶200-201 (citing EX-1008). The same signal ("a") on each of the three paths (red, blue, green) will take different amounts of time to travel between the transmitting device (upper right) and the receiving device (computer on lower left) because the signals travel at the same speed but have different distances to traverse. The "multipath transmission delay" measures these different travel times. EX-1003, ¶¶286-289. As detailed in Sections V.F and V.B, measuring multipath transmission delays and using it as channel information was known in the art long prior to the '369 Patent.

Element [1.1] recites that "determining at least one forward path pre-equalization parameter based on said at least one [multipath] transmission delay" from element [1.0]. This recites the well-known principle of using reverse channel information to calculate a parameter used to modify the signals transmitted on the forward path. EX-1003, ¶290.

A POSITA understood that Wong teaches the concept of determining a forward path pre-equalization parameter based on multipath transmission delay for several reasons. EX-1003, ¶¶290-298. First, Wong expressly identifies using reverse channel information to adjust the forward channel transmission. "In [Wong's] system, the base station (BS) can estimate the instantaneous channel characteristics of all the BS-to-mobile links based on the received uplink transmissions." EX-1005, 1748. "Using the channel information, … **the transmit power level will be adjusted** …." EX-1005, 1748. EX-1003, ¶¶128, 369. As discussed in the State of the Art section, multipath transmission delay was a well-known channel characteristic.

Second, Wong expressly identifies the problem of multipath interference as a "major problem" that Wong and the '369 Patent both address. EX-1003, ¶¶117, 291. "One of the main requirements on the modulation technique is the ability to combat **intersymbol interference** (ISI), a **major problem** in wideband transmission over **multipath fading channels**." EX-1005, 1748. Notably, the

(later) '369 disclosure mirrors Wong's language in identifying this problem: "High data rate communication systems may be subject to detrimental **intersymbol interference** caused by such **multipath propagation or fading**." EX-1001, 3:12-17; *see also* EX-1001, 3:35-37.

Third, based on Wong's teachings, a POSITA understood that using multipath transmission delays was one of a few known techniques to solve Wong's "major problem." Thus, a POSITA understood that Wong's channel characteristics would include "multipath transmission delay." EX-1003, ¶¶296-326 (discussing EX-1003, ¶¶195-197, 207-209, 167-170, 174-176, 188-190).

Wong's system teaches a BS communicating with multiple users. To represent a channel characteristic, Wong uses the power of each subcarrier for each user as measured at the BS. In particular, Wong "denote[s] by the magnitude of the channel gain … of the *n*th subcarrier as seen by the *k*th user" based on the "received uplink transmissions" for a "time division duplex (TDD) wireless communication system" that uses "OFDM." EX-1005, 1747-1748, EX-1003, ¶¶306-307, 313, 321, 371.

A POSITA would have known that such reverse / uplink channel characteristics can be measured using either: (1) a "time-domain" option or (2) a "frequency domain" option. Thus, at highest level, there were only two options – the epitome of "obvious to try." EX-1003, ¶¶299-305 Within the "time-domain

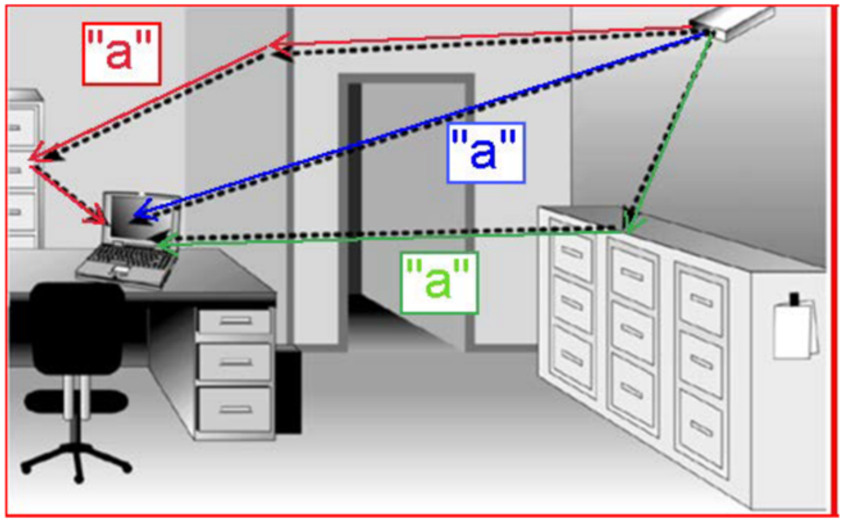
approach," a POSITA would have understood that such an approach involves two actions that were both well-known: (1) measure the time delay; and (2) converting that time delay to a frequency domain parameter. EX-1003, ¶¶289-333.

Specifically, within the known time-domain option, identifying and using the multipath transmission delay would have either been known or obvious to a POSITA. As Dr. Negus details, there were at least five separate known "time-domain" approaches applicable for channel estimation in OFDM at a BS with multiple users (the type of system used in Wong). EX-1003, ¶¶307, 167-176, 145, 188-190, 213-216. Each of those time-domain approaches uses a multipath transmission delay to estimate the channel characteristics. EX-1003, ¶¶308-312.

The following example explains the identification and determination of "multipath transmission delay" at a high conceptual level. As noted above, "multipath" reflects that the multiple copies of the same signal will arrive at the destination based on difference in the path that the signal takes. In the example below, the blue signal, the green signal and the red signal travel different paths from the transmitter to the receiver and arrive at different times –carrying the same data "a."

The receiver measures the received "energy" at different time intervals. These measurements are the "channel impulse response" which is a vector called "h[n]" where "n" is a "time-domain index." EX-1003, ¶¶303-309. The "time-

domain index" is the time when each signal arrives at the receiver (when the energy / amplitude for that signal is measured).



The **blue "a"** took a direct path and arrived first (*e.g.*, h[1]). The **green "a"** took longer to travel to the receiver with a single reflection and arrived at a later time (*e.g.*, h[4]). The **red "a"** took even longer and arrived even later (e.g., h[7]). The channel impulse response vector would be:

Time-domain index ("n")	**Channel impulse response ("h[n]")**
0	
1	**"a"**
2	
3	
4	**"a"**
5	
6	
7	**"a"**

The different time-domain indices ("n") for the same signal reflect the claimed "multipath transmission delay." Dr. Negus explains in detail that each of the five exemplary time-domain approaches include estimating the "channel impulse response" in the form of "h[n]" as depicted and described above. EX-

1003, ¶¶303-309, 167-176, 145, 188-190, 213-216. The different "n" indices identify each time (a "tap") within the estimated "channel impulse response" where a signal is measured and correspond to the claimed "multipath transmission delay." EX-1003, ¶¶303-309.

A POSITA also would have known that for each of the five exemplary time-domain approaches, a subsequent step after determining the time delay is to convert that time delay into a frequency domain. EX-1003, ¶¶310-312. In particular, as detailed by Dr. Negus, the known subsequent step after estimating the channel ***impulse*** response (the time delay above) is estimating the channel ***frequency*** response in the form of "$H[k]$" where "k" is a "***subcarrier index.***" It was well-known that such step occurs by performing a "***DFT***" or "***FFT***" operation on the estimated "***channel impulse response***." EX-1003, ¶310. The '369 Patent relies upon this already-known operation of FFTs. EX-1001, 14:56-59 ("FFTs … convert …time domain signals… into corresponding frequency domain signals.").

This "$H[k]$" (channel ***frequency*** response) is exactly the information that Wong uses for adjusting the power levels of each tone. Wong uses the term "magnitude of the channel gain" to reflect the channel estimation. Wong "denotes by $\alpha_{k,n}$ t<u>he magnitude of the channel gain of the nth subcarrier as seen by the kth user.</u>" EX-1005, 1748. EX-1003, ¶¶311, 320-321

The "$H[k]$" calculated by each time-domain approach specifies a <u>magnitude</u>

term (also called an "amplitude") and a phase term specific to each "***subcarrier index***" or "k." EX-1003, ¶311. Thus, the "$H[k]$" contains "***magnitude of the channel gain***" used by Wong for each of the OFDM subcarriers. EX-1005, 1748. Wong also references this "$H[k]$" as the "instantaneous channel **gains**" used to adjust the OFDM subcarrier power levels EX-1005, 1752, 1747 (Abstract). EX-1003, ¶¶294-295, 369-380.

Thus, in the context of Wong, using the time-domain approaches to estimate the "***channel frequency response***" in the form of "$H[k]$" or "$\widehat{H}[k]$" discloses the claimed "**determining at least one forward path pre-equalization parameter …**" because it discloses the "channel gain" magnitude (the claimed "parameter") that Wong uses to modify the forward path signals and it is "based on" the measured transmission delays (the "channel impulse response" discussed above).

i. Minn Expressly Teaches Identifying A "Multipath Transmission Delay" Used For "Determining At Least One Forward Path Pre-Equalization Parameter…."

To the extent that PO asserts that Wong does not expressly recite using "multipath transmission delay" as the channel information, Minn expressly teaches the details for calculating the channel information using a time-domain approach which identifies multipath transmission delay. *E.g.*, EX-1006, Title ("An Investigation into Time-Domain Approach for OFDM Channel Estimation"); EX-

1003, ¶¶334-349.

Minn proposes "time-domain based channel estimation for OFDM system" based upon application of the "most significant channel taps selection" ("MST") technique. EX-1006 at 240 (Abstract), 242-244. Accordingly, Minn's MST approach uses two forms: (1) first form that uses "intra-symbol time-averaging;" and (2) a second form, referred to as the "MST dual form DFT-based method."[3] EX-1003, ¶¶339-342.

For each of Minn's time-domain approaches, Minn performs the time-domain channel estimate as described above for Wong. Minn calculates the "channel impulse response" (discussed above) by identifying the "delay" between the different versions of the same signal arriving at the receiver due to those different versions traveling over different paths from the transmitter to the receiver. EX-1003, ¶¶339-342.

Annotated Fig. 2 below highlights how Minn's teaching correspond to the claim elements.

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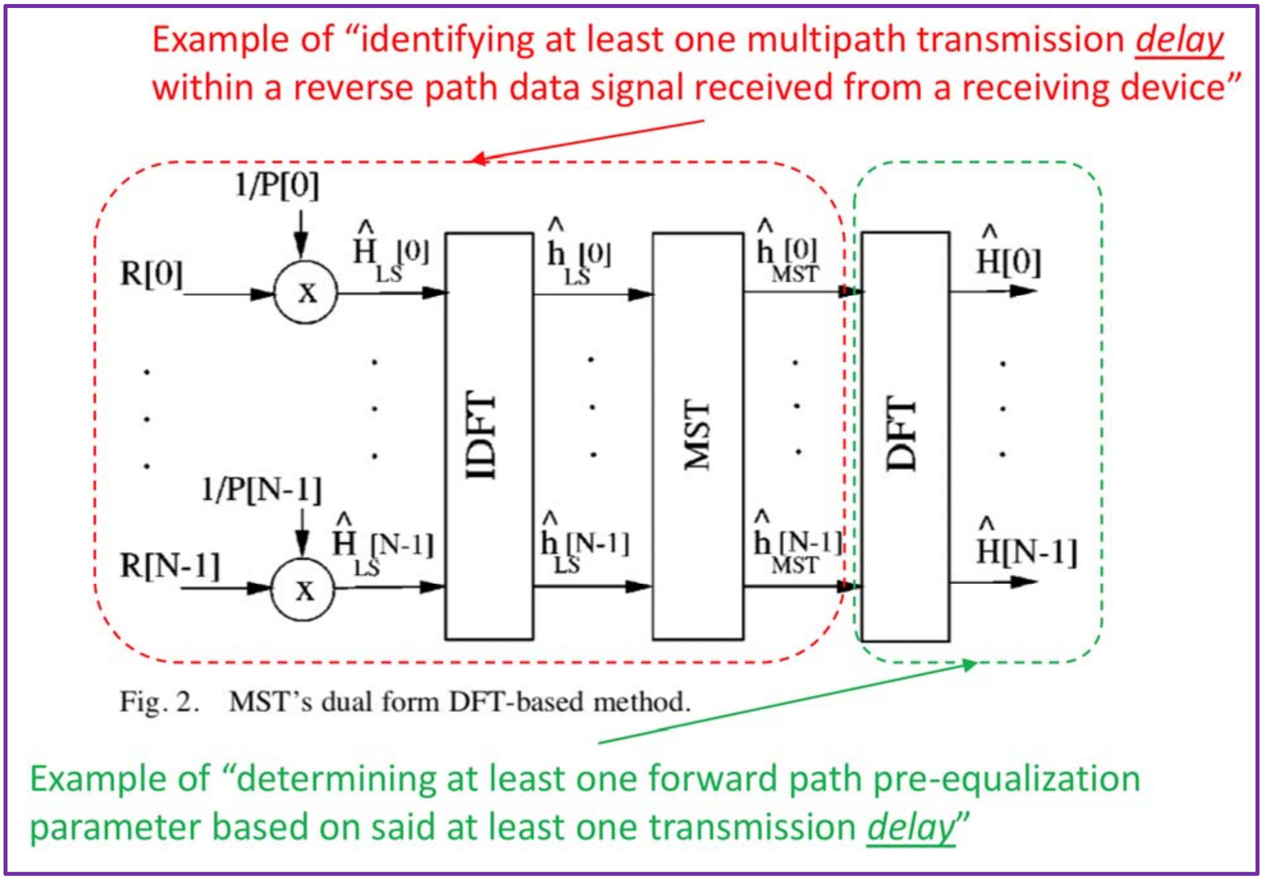
[3] "FFT" and "DFT" are often used interchangeably as known to a POSITA.



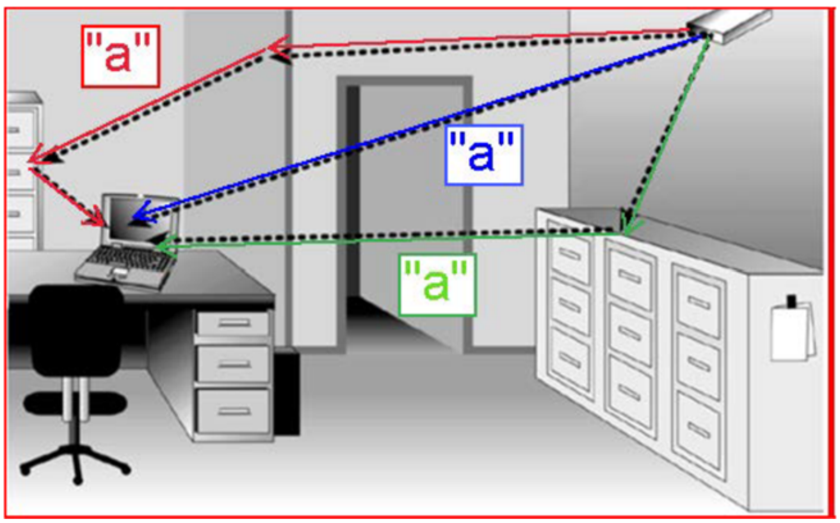
EX-1003, ¶¶339-341.

Minn teaches to perform first a "raw channel impulse response estimate" denoted as "$\hat{h}_{LS}[n]$" (the output of the "***IDFT***" block in annotated Fig. 2 shown above). Minn then teaches calculating an "MST channel impulse response estimate" denoted as "$\hat{h}_{MST}[n]$" (the output of the "***MST***" block in annotated Fig. 2 shown above). Minn's Eq. (23) teaches this calculation that is depicted in Figure 2. EX-1003, ¶¶339-342. EX-1006 at 243 (Eq. 23).

At this point, Minn has measured and populated the "h[n]" "channel impulse response" vector discussed above for Wong. This h[n] vector contains

measurements in each of the "n" elements (which are samples over time).

Minn then identifies the indices that showed the measured signals which Minn references as the "most significant taps." So, for the blue/green/red discussed above (and shown below), Minn teaches identifying the "blue" index (which in the example above was "1"), the green index (in the example above was "4") and red index (in the example above was "7")



"[T]he channel tap indexes for those most significant J taps" are "n_i" in Eq. (23) shown above as "denoted by $n_0, n_1, \cdots, n_{J-1}$" or as shown as the output of the "MST" block in annotated Fig. 2 above. EX-1006, 243. EX-1003, ¶¶341-342. Thus, the MST would output a vector that, in our example, had "1", "4," and "7" as the elements because those are the time-domain indices corresponding to the blue, green and red signals arriving at the receiver. An example of the "most significant taps" of the channel impulse response vector is shown in Minn's Table I:

TABLE I
CHANNEL IMPULSE RESPONSE FOR CHANNEL-B

Delay (OFDM samples)	Gain	Phase (radians)
0	0.2478	-2.5694
1	0.1287	-2.1208
3	0.3088	0.3548
4	0.4252	0.4187
5	0.4900	2.7201
7	0.0365	-1.4375
8	0.1197	1.1302
12	0.1948	-0.8092
17	0.4187	-0.1545
24	0.3170	-2.2159
29	0.2055	2.8372
49	0.1846	2.8641

EX-1006, 245. This example contains 12 taps at which the received pilot signal was detected. Minn presents several examples of using this data to calculate the parameters for adjusting the transmissions. EX-1006, 244-247.

A POSITA would have known that this vector of the Minn's "channel tap index" or "n_i" identifies these "most significant channel taps" within the "MST channel impulse response estimate" identifies the different times at which the known signal was detected at the receiver. These different times accordingly discloses the "at least one multipath transmission delay" recited for this claim element. EX-1003, ¶¶341-342.

After calculating this "time-domain based channel estimation for OFDM system" (multipath transmission delay), Minn teaches using FFT to convert from time-domain to frequency-domain. "The resulting MST channel impulse response estimate is input to FFT block to get the MST channel frequency response

estimate." EX-1006 at 243. This is shown in annotated Fig. 2 above as the output of the "DFT" block and is depicted "$\hat{H}[0] \cdots \hat{H}[N-1]$" in Fig. 2 and by Eq. (24). EX-1006 at 243, EX-1003, ¶343.

As noted in the Wong analysis, this "$H[k]$" provides exactly the information that Wong uses as a parameter to modify the forward link transmissions – the amplitude/magnitude of the channel response specific to each "***subcarrier index***" or "k." EX-1003, ¶¶344-346. Wong then uses this "magnitude" of the channel gain estimate to modify each of the subcarrier power levels as discussed above and in element [1.2] below.

Minn's estimate of the "***channel frequency response***" in the form of "H[k]" or "Ĥ[k]" discloses the "at least one forward path pre-equalization parameter" recited for this claim element because it discloses the "channel gain" magnitude that Wong uses to modify the forward path signals. EX-1003, ¶¶339-346.

Thus, Minn expressly discloses the claimed "determining at least one forward path pre-equalization parameter" (the "amplitude" of "$H[k]$" [the channel frequency response]) that is "based on said at least one transmission delay" (the "channel tap indexes" or "n_i" for the "MST channel impulse response estimate" corresponding to the "largest amplitude J channel taps").

ii. A POSITA Would Have Been Motivated To Combine Wong With Minn's Form Of Channel Estimation With A Reasonable Expectation Of

Success.

Wong and Minn fit like a glove. EX-1003, ¶¶346-359. Wong improves downlink OFDM transmissions by adaptively setting OFDM subcarrier power levels based on "assuming knowledge" of the uplink channel information. Minn provides the "knowledge" that Wong "assum[es]" by teaching an improved method of calculating the uplink channel information with the expressed purpose of improving the downlink OFDM transmissions using "power allocation across the [OFDM] subcarriers according to the channel conditions." EX-1006, 240.

Wong presents an improvement to OFDM systems with (1) a "base station (BS) can <u>estimate the instantaneous channel characteristics</u> of all the BS-to-mobile links based on the received uplink transmissions" and (2) "Using the channel information" (the estimated channel characteristics on the uplink channel), the BS "applies the combined subcarrier, bit, and power allocation algorithm to assign different subcarriers to different users and the number of bits/OFDM symbol to be transmitted on each subcarrier…and the transmit power level will be adjusted according to the combined subcarrier, bit, and power allocation algorithm." EX-1005, 1748, EX-1003, ¶347.

Wong focuses on #2 (the modifications) but needs good channel estimates (#1) to optimize Wong's algorithm to improve the downlink transmission. Wong assumes good channel estimates. *E.g.*, EX-1005, 1747 ("Assuming knowledge of

the instantaneous channel gains for all users…); 1747 ("Assuming the transmitter knows the instantaneous channel transfer functions of all users…");1748 ("We assume … that the instantaneous channel gains on all the subcarriers of all the users are known to the transmitter").

Minn focuses on providing the details of the channel estimates that include the instantaneous channel gains that can be used with Wong's teachings. EX-1003, ¶¶349-357. Moreover, Minn functions exactly as Wong expects because Minn will "estimate the instantaneous channel characteristics of all the BS-to-mobile links based on the received uplink transmissions." EX-1005, 1748.

Minn not only provides a methodology for determining such "instantaneous channel characteristics" of "received uplink transmissions" over "multipath fading channels" as needed in Wong, but Minn's ***first paragraph*** recites that Minn's teachings are directed specifically to "Orthogonal frequency division multiplexing (OFDM)" with "<u>adaptive</u> modulation and <u>power allocation across the subcarriers according to the channel conditions</u>" – which is exactly the application of OFDM that Wong uses. EX-1006, 240; EX-1003, ¶¶352-353.

Given the heavy overlap and matching of Wong and Minn, a POSITA would have been highly motivated to specifically supplement Wong's teachings with the teachings of Minn. This is particularly true because Minn teaches that its approach for channel estimation provides a significant "performance gain" compared to

conventional "frequency domain" approaches. EX-1006, 242-243; EX-1003, ¶¶353-354.

Furthermore, Minn's techniques will improve channel estimation by improving the reception sensitivity for the base station regarding the "estimate [of]the instantaneous channel characteristics of all the BS-to-mobile links based on the received uplink transmissions" used in Wong. EX-1003, ¶355.

A POSITA would have an expectation of success in the combination. Both systems present improvements to known OFDM transmission techniques. They use similar terminology, similar technologies, and present complementary solutions. EX-1003, ¶¶356-358.

[1.2] modifying a forward path data signal that is to be transmitted to the receiving device based on said at least one forward path pre-equalization parameter, where said modifying includes selectively setting different transmission power levels for at least two Orthogonal Frequency Division Multiplexing (OFDM) tones in said forward path data signal.

Wong discloses the element. EX-1003, ¶¶360-382. As described in the overview of Wong above, using the channel characteristics, Wong's BS will modify the forward link transmissions (to the mobile devices) by changing the power levels for different OFDM tones (*i.e.*, "subcarriers"). Wong's "power allocation algorithm" "assign[s] each user a set of subcarriers and by determining the number of bits and the **transmit power level for each subcarrier**." EX-1005

at 1747 (Abstract). Wong's system "adaptively assign[s] subcarriers to the users along with the number of bits and power level to each subcarrier." EX-1005 at 1757.

> Using the channel information, the transmitter applies the combined subcarrier, bit, and power allocation algorithm to assign different subcarriers to different users and the number of bits/OFDM symbol to be transmitted on each subcarrier. Depending on the number of bits assigned to a subcarrier, the adaptive modulator will use a corresponding modulation scheme, and the transmit power level will be adjusted according to the combined subcarrier, bit, and power allocation algorithm.

EX-1005 at 1748. "As different subcarriers experience different fades and transmit different numbers of bits, the transmit power levels must be changed accordingly." EX-1005, 1747. EX-1003, ¶¶376-380. Moreover, Wong's repeated reference to "adaptive" or "adaptively" setting OFDM power levels teaches that such settings are "based on" the reverse channel information (the information to which the power levels are being "adapted").

Wong details the specific algorithms for adjusting the power levels for multiple OFDM tones (subcarriers) on pp. 1749-1756 including Figure 1 (as annotated above).

Minn's first paragraph also discloses this element in discussing "OFDM" with "adaptive modulation and power allocation across the subcarriers according to

<u>the channel conditions.</u>" EX-1006, 240.

b. <u>Claim 2</u>

[2] The method as recited in claim 1, further comprising receiving said reverse path data signal over at least one reverse transmission path.

Wong, alone or in combination with Minn, discloses this limitation for the reasons set forth for limitation [1.0] and [1.1]. EX-1003, ¶¶383-387. For example, Wong states "the <u>base station</u> (BS) can <u>estimate the instantaneous channel characteristics</u> of all the BS-to-mobile links <u>based on the received uplink transmissions.</u>" EX-1005, 1748. These "uplink transmissions" correspond to the reverse data path signal. Minn's channel estimations are based on the "received samples" from the channel. EX-1006, 241-243.

c. <u>Claim 3</u>

[3] The method as recited in claim 2, further comprising transmitting said modified forward path data signal over at least one forward transmission path.

As discussed for limitation [1.2], Wong discloses transmitting said modified forward path data signal over at least one forward transmission path. EX-1003, ¶¶388-392. For example, Wong states "the adaptive modulator will use a corresponding modulation scheme, and the <u>transmit</u> power level will be <u>adjusted</u> according to the combined subcarrier, bit, and power allocation algorithm. … The <u>transmit signal</u> is then passed through different frequency selective fading channels to different users." EX-1005, 1748. The "transmit signal" corresponds to the

modified forward path data signal.

d. Claim 4

[4] The method as recited in claim 1, wherein said reverse path data signal includes at least one type of data selected from a group of different types of data comprising Orthogonal Frequency Division Multiplexing (OFDM) data and Quadrature Phase Shift Keying (QPSK) data.

Wong, alone or in combination with Minn, discloses this limitation. EX-1003, ¶¶393-399. Wong discloses "OFDM" used on both the reverse and forward links and thus meets this claim. EX-1005, 1748.

Wong also discloses using QPSK data. Wong discloses an exemplary "system that employs M-ary quadrature amplitude modulation (MQAM)" using "Square signal constellations (4-QAM, 16-QAM, and 64-QAM)." EX-1005, 1752. A POSITA would understand that the terms "4-QAM" and "QPSK" were routinely used interchangeably at the time of the alleged invention of the '369 Patent. The "4-QAM" and "QPSK" signal constellations are effectively interchangeable prior to acquiring a coherent phase reference in a receiver since each signal constellation has 4 constellation points of equal amplitude and 90º phase separation. EX-1003, ¶¶395-397. For example, U.S. Pat. No. 6,594,318 (EX-1009) explicitly teaches in reference to a depiction of a "Square signal constellation" for "4-QAM" that such "4QAM constellation" is "more commonly known as a QPSK constellation." EX-1009, 21:29-31. See also EX-1009, 19:61-63, 20:57-58, FIG. 9. EX-1003, ¶¶396,

220, 230-231.

Thus, Wong teaches, or renders obvious, both OFDM and QPSK.

e. Claim 5

[5] The method as recited in claim 1, wherein said modified forward path data signal includes at least one type of data selected from a group of different types of data comprising Orthogonal Frequency Division Multiplexing (OFDM) data and Quadrature Phase Shift Keying (QPSK) data.

Wong, alone or in combination with Minn, discloses this limitation for the reasons for limitations [1.2], [4]. Wong uses both OFDM and QPSK on both forward and reverse paths. EX-1003, ¶¶400-406.

f. Claim 6

[6] The method as recited in claim 5, wherein said modified forward path data signal includes sub-carrier pre-equalized OFDM data.

Wong, alone or in combination with Minn, discloses this limitation for the reasons for limitations [1.2], [3], [4], [5]. EX-1003, ¶¶407-412. As detailed in [1.2], Wong teaches the pre-equalization of the power in each OFDM subcarrier transmitted on the forward path.

g. Claim 7

[7] The method as recited in claim 6, further comprising: generating corresponding Quadrature Phase Shift Keying (QPSK) modulation values based on said sub-carrier pre-equalized OFDM data.

Wong, alone or in combination with Minn, discloses this limitation for the reasons for Claim [1.2], [4], [5], [6]. As detailed in [4], Wong's disclosure of 4-

QAM discloses QPSK modulation which is generated based on the OFDM data that Wong teaches should be pre-equalized using Wong's algorithm. EX-1003, ¶¶413-418.

h. <u>Claim 9</u>

[9] The method as recited in claim 1, wherein said reverse path data signal includes identifiable training data.

Wong, alone or in combination with Minn, discloses this limitation. EX-1003, ¶¶419-431.

First, Minn expressly discloses this limitation. Minn discloses that "Pilot tones can be inserted in all subcarriers of a particular OFDM symbol forming an OFDM training symbol, in which case training symbols are transmitted at an appropriate regular rate determined by the time varying nature of the wireless channel." EX-1006, 240. Minn also states the "MST dual form DFT-based method" as specifically applicable for a "system with training symbol (i.e., pilot tones on all subcarriers)." EX-1006, 240, Fig. 2. EX-1003, ¶¶425-426.

Second, Wong renders this element obvious. EX-1003, ¶¶419-424. As detailed above for [1.0], [1.1], Wong discloses using the uplink channel to estimate the downlink and that Wong renders obvious the use of the "time-domain" approaches for estimation. The use of those time-domain approaches renders the use of identifiable training data obvious because the "identifiable training data" is the known data that allows detection and comparison of the multipath signals.

The known prior art time-domain methodologies discussed in [1.1], used the claimed "identifiable training data." These known time-domain methodologies used: (1) a "training symbol (i.e., pilot tones on all subcarriers)," (2) "insert[ed] pilot tones into all of the carriers in an OFDM symbol," or (3) "IEEE 802.11a standard training symbols." Each of these corresponds to the claimed training signal. EX-1003, ¶¶421, 328-330.

Given that "time-domain" approaches were obvious to try (as one of two different approaches) and that the majority of such time-domain approaches rely upon training data, Wong's disclosure in view of the knowledge of a POSITA renders this claim obvious. EX-1003, ¶¶419-431.

i. Claim 10

> ***[10] The method as recited in claim 9, further comprising comparing said identifiable training data to a local version of said training data to identify said at least one multipath transmission delay within said reverse path data signal.***

Wong, alone or in combination with Minn, discloses this limitation for the reasons for Claim 9. EX-1003, ¶¶432-441. First, the claimed "comparing" is obvious over the use of training data as recited in claim 9 for the Examiner's reason during prosecution (without challenge by the applicant): "it is known in the art to compare a received training sequence with a local training sequence so as to

provide proper indication of transmission medium." EX-1002, 0074.[4]

Second, Minn expressly teaches this comparison as shown in the annotated Fig. 2 below:

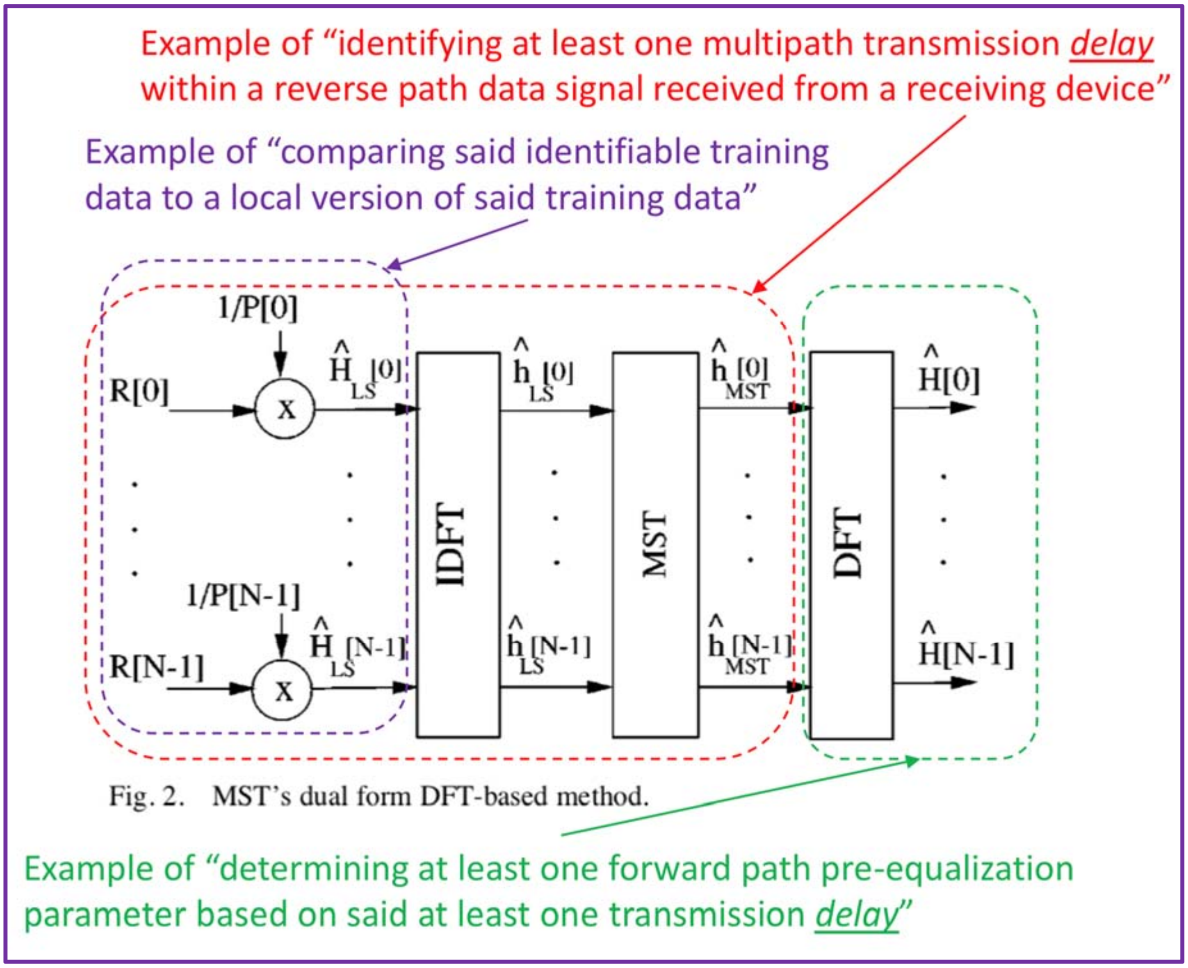


Fig. 2. MST's dual form DFT-based method.

EX-1003, ¶¶439-440.

The claimed "comparing" is shown by the as-received training symbol

[4] The '369 specification does not recite any "local version" of a training symbol and refers, at most, to a "known" sequence. *E.g.*, EX-1001, 11:50-51, Abstract.

(vector R[k]) with the actual training symbol as it was transmitted (vector P[k]) in the form of a sequence of multiplications of R[k] with 1/P[k] in Fig. 2. "P[k]" is the symbol before it was transmitted (the known "local version" of the training data stored on the BS). EX-1006, 240. The "R[k]" is a vector reflecting the received version (at the BS) of the pilot training tone. The "X" multiplication of the two vectors (the "received" and the original "known" transmitted pilots) is how vectors are compared. Essentially, it allows a determination / quantification of the differences in the vectors which corresponds to the claimed "comparing." EX-1003, ¶¶439-440.

Third, the disclosure of Wong discussed in claim 9 renders the claimed comparison obvious. EX-1003, ¶¶432-437. For the three different known prior art methodologies discussed in claim 9, each methodology included steps that a POSITA would understand to show comparing the as-received training symbol with the actual training symbol. For example, with the "Time Pilot Time Correlation (TPTC)" time-domain method, the claimed "comparing" is recited using the same language as the '369 Patent: "the channel response is estimated using the correlation of received pilot signal and the locally stored PN sequence." EX-1007, 401. EX-1003, ¶434. *See* EX-1001, 11:50-51 ("cross-correlated the signals with known sequences…"). *See also* EX-1003, ¶¶434, 174, 189, 216 (detailing comparisons for the time-domain approaches).

As a further example, for the "***MST dual form DFT-based method***," this claimed comparison is shown in the disclosure of Minn discussed immediately above. EX-1003, ¶¶439-440.

Thus, comparing a received signal with a known reference signal to identify the multipath delay was well-known and obvious over the prior art.

j. Claim 12

[12] The method as recited in claim 3, wherein said at least one reverse transmission path is substantially reciprocal to said at least one forward transmission path.

Wong, alone or in combination with Minn, discloses this limitation for the reasons for limitations [1.1], [2]. EX-1003, ¶¶443-455. As noted in [1.1], Wong teaches a reciprocal channel in its teaching that "the base station (BS) can estimate the instantaneous channel characteristics of all the BS-to-mobile links based on the received uplink transmissions." EX-1005, 1748. Such ability to use the uplink channel to estimate the downlink channel reflects that the forward transmission path is substantially reciprocal to the reverse path. EX-1003, ¶¶445-447. The '369 Patent acknowledges reciprocity was "well-known" prior to the '369 Patent. EX-1001, 7:22-33.

k. Claim 13

[13] The method as recited in claim 1, wherein identifying said at least one multipath transmission delay, determining said at least one forward path pre-equalization parameter, and modifying said forward path data signal are performed by a transmitting device.

Wong, alone or in combination with Minn, discloses this limitation for the reasons for limitations [1.1], [1.2]. EX-1003, ¶¶456-459. As noted in [1.1], Wong teaches a "base station (BS)" that performs the channel estimation modifies the power for each OFDM tone and transmits the data to a "mobile" device. The BS is a transmitting device.

l. <u>Claim 14</u>

[14] The method as recited in claim 13, wherein said transmitting device includes a base station device that is operatively configured for use in a wireless communication system.

Wong "base station" discloses this limitation for the reasons for limitations [1.1], [1.2], [13]. EX-1003, ¶¶460-463.

m. <u>Claim 15</u>

[15] The method as recited in claim 13, further comprising: using at least one transmitting device receive antenna operatively coupled to said transmitting device to receive said reverse path data signal over at least one reverse transmission path from the receiving device.

Wong, alone or in combination with Minn, discloses this limitation for the reasons for limitations [1.1], [1.2], [13]. EX-1003, ¶¶464-470. A POSITA would have understood that such antennas are disclosed (or obvious) by Wong's teaching of a base station that transmits/receives data – just as the Examiner determined (without challenge) during prosecution even though such prior art (Yamamoto, EX-1004) did not disclose any "antenna" in either text or figures. EX-1002, 0072.

n. <u>Claim 41</u>

[41] The method as recited in claim 1, wherein determining said at least one forward path pre-equalization parameter based on said at least one transmission delay further includes sub-band equalizing said forward path data signal using corresponding frequency domain reverse path data.

Wong, alone or in combination with Minn, discloses this limitation for the reasons discussed for limitation [1.1], [1.2] EX-1003, ¶¶557-567. First, as the Examiner noted and not disputed by the applicant, "it would have been obvious to one skill in the art to subband equalize said forward path using corresponding reverse path data so as to remove interference." EX-1002, 0076.

A POSITA would understand that the plain ordinary meaning of "**sub-band equalizing said forward path data signal**" in the context of an OFDM system would at least include performing equalization in the forward path across a group or band of related subcarriers instead of across each subcarrier individually. EX-1003, ¶558. For example, the '369 Patent describes a technique that "essentially acts a sub-band equalizer in the transmitting node (here, the base station device)" wherein "power may be set to be equal in each of the sub-bands, allowing regulatory rules, such as FCC rules, to be satisfied" while "the power may be substantially flattened over the spectrum." EX-1001, 15:21-29. This description from the '369 Patent is consistent with the plain, ordinary meaning of "sub-band equalizing said forward path data signal" as equalization in the forward path across a group or band of related subcarriers. EX-1003, ¶559.

Wong teaches that "the bit and power allocation algorithm can be applied to each user on its allocated subcarriers" for "downlink transmission in a time division duplex (TDD) wireless communication system to improve the downlink capacity" but also notes that "there is a certain amount of transmission overhead as the BS has to inform the mobiles about their allocated subcarriers and the number of bits assigned to each subcarrier" even in a "TDD system." EX-1005, 1748. Wong further teaches that "To further reduce the overhead, we can assign a contiguous band of subcarriers with similar fading characteristics as a group, instead of assigning each individual subcarrier." EX-1005, 1748. EX-1003, ¶562.

Accordingly, a POSITA understood that to "reduce the overhead" associated with application of the "power allocation algorithm" to "each user on its allocated subcarriers" using such "magnitude of the channel gain" as derived from the "received uplink transmissions" (i.e. "equalizing said forward path data signal using corresponding frequency domain reverse path data") that Wong also discloses to instead perform such application of the "power allocation algorithm" to a "contiguous band of subcarriers with similar fading characteristics as a group" (*i.e.* to a "sub-band" in the terminology of this claim element). EX-1003, ¶563.

Thus, Wong, alone or in combination with Minn, discloses this claim to a POSITA. EX-1003, ¶¶564-567.

B. Ground 2: Claims 15, 19, 21, 28, 32-33 and 35-37 are unpatentable over Wong (alone or combined with Minn) combined further with Lehne.

Ground 2 adds the Lehne antenna reference to Ground 1.

To be clear, during prosecution, the Examiner held every "antenna" claim below to be obvious over Yamamoto (EX-1004) – a reference that discloses a base station (like Wong) but does not mention the word "antenna." EX-1002, 0074-0076. The applicant did not dispute or challenge the Examiner's holding on the antenna claims. This is unsurprising because each of the antenna claims recites technology that would have already been known to a POSITA and thus obvious over Wong. Lehne is an express manifestation of the knowledge of at POSITA regarding antenna technology.

1. Overview of Lehne

Lehne is an IEEE publication that shows the known state of the art in 1999 for "Smart Antenna Technology for Mobile Communications Systems." EX-1006, 2. EX-1003, ¶¶232-257. Lehne teaches the theory and desirability of "smart antennas" in wireless systems. EX-1006, 3-6. Lehne teaches various implementations and explains that, as of 1999, numerous companies had been testing and using such "smart antennas" in the field. EX-1006, 6-11 ("Implementation"), 12 ("Trials and Testbeds").

Lehne's "smart antennas" can use techniques such as antenna arrays

(including phased arrays) to perform beamforming techniques as well as provide directional transmissions. EX-1006, 4, Figure 3. Lehne teaches all of the elements of the Challenged Claims related to antennas as detailed below.

2. Motivation to Combine Wong and Minn with Lehne with a reasonable expectation of success.

A POSITA would have been highly motivated to modify the teachings of Wong to use smart antennas as taught by Lehne for at least the following reasons. EX-1003, ¶¶478-492.

First, Wong's goal is to "improve the downlink capacity" for "downlink transmission in a time division duplex (TDD) wireless communication system" subject to "multipath fading channels. EX-1005, 1748. Wong also notes that "interference" is a "major problem." EX-1003, ¶¶479-482.

As Dr. Negus explains, a POSITA understood that from the prior art at the time of the alleged invention of the '369 Patent that there is "tremendous capacity potential for wireless communication systems using antenna diversity" which is "multiple independent channels between transmitters and receivers." EX-1003, ¶¶480-481, 221-222 (citing EX-1008, 0124-0172). Moreover, the prior art had already taught that "OFDM systems are particularly well-suited for enhanced capacity using antenna diversity techniques." EX-1008, 0124 (discussing EX-1014); EX-1003, ¶¶221-222.

Using Lehne's "smart antenna" furthers Wong's "capacity" goal and

addresses Wong's "interference" major problems. Lehne discloses that "The principle reason for the growing interest in smart antennas is the capacity increase." EX-1010 at 5 (section entitled "Capacity Increase"). See also EX-1010, Abstract ("principle reason for introducing smart antennas is the possibility for large increase in capacity"); 4 ("system capacity increases"); 12 (ongoing "trial confirm the capacity increase of a smart antenna"); 3 ("In addition to increase capacity…"); 12 ("It is obvious that smart antennas at the base stations will be an important technology to provide the necessary capacity and coverage.").

Second, using Lehne's smart antennas directly address Wong's "interference" major problem. While "mobile systems are normally interference-limited", "[s]mart antennas" operate by "simultaneously increasing the useful received signal level and lowering the interference level", thereby providing a "capacity increase of 300 percent" or alternatively a "fivefold capacity gain." EX-1010, 5. EX-1003, ¶¶481-482.

Given Wong's goal of capacity improvements (a general goal in wireless transmissions), a POSITA would have been motivated to modify Wong's teachings to include smart antennas as taught by Lehne at least because the disclosures of Wong are directed to "improve the downlink capacity." Moreover, because the prior art teaches that combining "OFDM" such as used in Wong with "antenna diversity" such as used in Lehne would increase capacity, and because Lehne also

teaches "smart antennas" provide a "large increase in capacity", then a POSITA would have been highly motivated to combine the "smart antennas" disclosures of Lehne with Wong's improvement (e.g., "multiuser OFDM subcarrier, bit, and power allocation algorithm" at a "base station (BS)" in a "time division duplex (TDD) wireless communication system"). This combination would even further increase capacity as would be a common sense action in view of well-known market forces at the time of the alleged invention of the '369 Patent for a BS that highly value capacity.

A POSITA would have an expectation of success when combining the "smart antenna" teachings of Lehne with Wong's teach of "multiuser OFDM subcarrier, bit, and power allocation algorithm" at a "base station (BS)" in a "time division duplex (TDD) wireless communication system" of Wong. EX-1003, ¶¶483-494. Lehne expressly discloses that a smart antenna is suitable for use with a "time division duplex (TDD) system" at a "base station" (EX-1010 at 10) that matches the "base station (BS)" in a "time division duplex (TDD) wireless communication system" of Wong. EX-1005, 1748.

The Wong and Lehne technologies overlap. For example, a POSITA would have known that the output of the "[l]obe forming unit" in the "[r]eception part of a smart antenna" is analogous to the disclosure of "received uplink transmissions" in the "base station (BS)" of Wong. Similarly, the input to the "[l]obe forming unit"

in the "[t]ransmission part of a smart antenna" is analogous to the disclosure of "downlink transmission" in the "base station (BS)" of Wong. EX-1003, ¶484.

Accordingly, a POSITA would have known that the "smart antenna" system of Lehne can be substituted for the ""dumb"/fixed antenna" that is effectively assumed by the disclosures of Wong and its base station. EX-1003, ¶485.

Additionally, Lehne specifically reports that its "smart antenna" approaches have been successfully deployed with a "time division duplex (TDD) wireless communication system", which a POSITA would associate with Wong, by real-world examples such as the "first trial to demonstrate commercial traffic through base stations equipped with smart antennas" for "GSM1800" (a "time division duplex (TDD) system") as well as "smart antenna solutions for the GSM standard and for the Japanese Personal Handyphone System (PHS)" (each a "time division duplex (TDD) system") as shown by "Field trials" performed in the USA. EX-1003, ¶¶486, 256-257.

Third, a POSITA would understand from the disclosure of Lehne that all "smart antenna" approaches of Lehne are applicable to the combination of Wong (including, as necessary, Minn) in view of Lehne. EX-1003, ¶¶487-489.

For example, Lehne discloses that while "the benefits of using smart antennas are many, there are also drawbacks and cost factors" associated with each of the "Switched lobe (SL)", "phased array (PA)" and "Adaptive array (AA)"

approaches because the "benefits" of "capacity increase" for each respective approach are correlated with being "more expensive" for a "base station" using the respective approach. EX-1003, ¶¶491-493.

More specifically, Lehne teaches that the simplest "Switched lobe (SL)" approach is "easier to implement in existing cell structures" but provides only a "limited improvement" while the "phased array (PA)" approach has "greater gain potential than switched lobe" but needs "separate transceiver chains for each of the array antenna elements" and further the most complex "Adaptive array (AA)" approach provides an "additional increase in capacity" in the form of "more users per carrier" but requires a "computationally intensive process" associated with the "beamforming." EX-1003, ¶¶490-492.

However, a POSITA would also understand that since the combination of Wong in view of Lehne involves a substitution of a ""dumb"/fixed antenna" approach in Wong for any one of the three "smart antenna" approaches of Lehne, then accordingly, the common sense understanding of a POSITA for the market forces applicable to any particular "base station" would render obvious the choice of which among the three "smart antenna" approaches of Lehne would be chosen as a tradeoff between the "benefits" and the "cost factors." EX-1003, ¶491.

3. Detailed Application of Wong in combination with Minn in further view of Lehne

The claims discussed below all include known antenna technologies

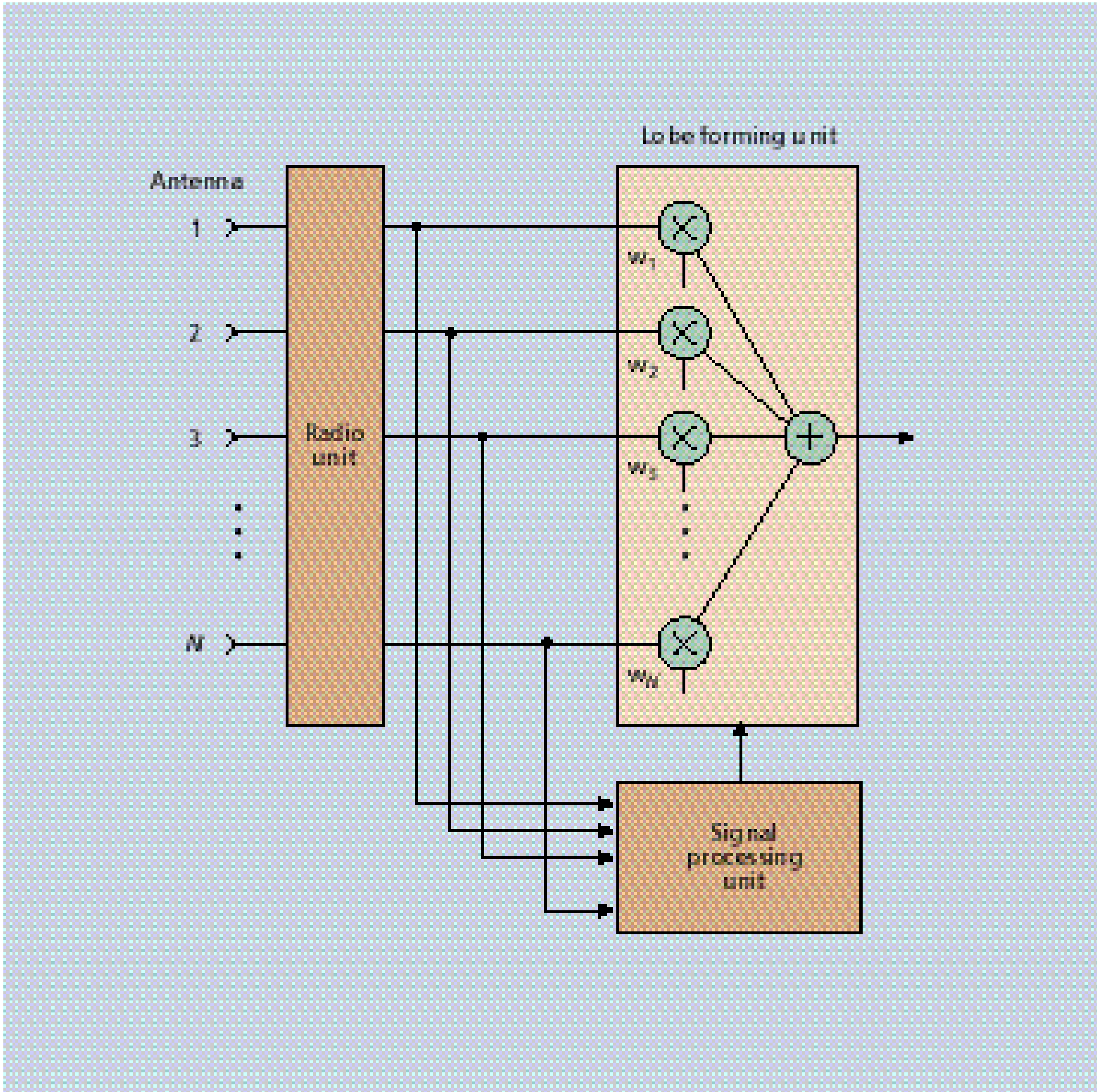
disclosed by Lehne.

a. <u>Claim 15</u>

[15] The method as recited in claim 13, further comprising using at least one transmitting device receive antenna operatively coupled to said transmitting device to receive said reverse path data signal over at least one reverse transmission path from the receiving device:

Wong, in combination with Minn and/or Lehne, discloses this limitation for the reasons discussed for limitation [1.0], [13]. As an initial matter, this claim is obvious for the Examiner's reason stated during prosecution: "it would have been obvious to couple the device with a plurality of antenna to enhance signal detection." EX-1002, 0074, 0072.

Lehne's BS uses one or more receive antennas to receive the transmissions from mobile devices. EX-1010 at 4, 5, 8-10 ("Receiver" section). Lehne's "Figure 12 shows … the reception part of a smart antenna." EX-1010, 8.



EX-1010, Fig. 12. Lehne's smart antennas can include different forms of antenna arrays used for transmission and reception. EX-1010, 6-8.

b. <u>Claim 19</u>

[19] The method as recited in claim 15, wherein said transmitting device is operatively coupled to a plurality of first device receive antennas.

Wong, in combination with Minn and/or Lehne, discloses this limitation for the reasons for limitations [1.0], 15. EX-1003, ¶¶471-494.

As shown for claim 15, Lehne discloses multiple receive antennas including arrays each with a plurality of antenna elements. EX-1003, ¶¶471-477.

c. **Claim 21**

> ***[21] The method as recited in claim 15, wherein determining said at least one forward path pre-equalization parameter based on said at least one transmission delay further includes determining at least one angle of arrival of said reverse path data signal with respect to said at least one transmitting device receive antenna.***

Wong, in combination with Minn and/or Lehne, discloses this limitation for the reasons for limitations [1.1], 15. EX-1003, ¶¶498-505.

Lehne expressly teaches that its BS will determine at least one angle of arrival of the signal from its associated users. EX-1003, ¶¶498-502. Lehne refers to "angle of arrival" as the "direction of arrival" or "DoA" and provides specific reasons for using this information (*e.g.*, a motivation to combine). For example, Lehne teaches that the DoA can be used to track users to maximize received power of transmission and to "receive multipath signals" from users:

> *Dynamically phased array (PA)*: By including a *direction of arrival* (DoA) algorithm for the signal received from the user, continuous tracking can be achieved and it can be viewed as a generalization of the switched lobe concept. In this case also, the received power is maximized.
>
> *Adaptive array (AA)*: In this case, a DoA algorithm for determining the direction toward interference sources (e.g., other users) is added. The radiation pattern can then be adjusted to null out the interferers. In

> addition, by using special algorithms and space diversity techniques, the radiation pattern can be adapted to receive multipath signals which can be combined. These techniques will maximize the *signal to interference ratio* (SIR) (or signal to interference and noise ratio (SINR)).

EX-1010, 4. Lehne also teaches that such direction information can be used for handovers. EX-1010, 5. Lehne teaches the math and theory in determining such direction of arrival. EX-1010, 7-8.

Lehne also teaches that such information can be used to impact the antenna weights used for reception of signals, such as multipath signals. EX-1010, 9. EX-1003, ¶¶499-500. Lehne notes a "number of well documented methods exist for estimating the DoA, for instance, MUSIC, ESPRIT, or SAGE" and cites references with such teachings. EX-1010, 9.

Lehne further teaches that such DoA information can be used to adjust the downlink transmissions to direct the transmission to a specific user and to minimize interference toward that user.

> Thus optimum beamforming (i.e., AA) on downlink is difficult, and the technique most frequently suggested is the geometrical approach of estimating the direction-of-arrival (DoA). …The strategy used by the base station is to estimate the DoA of the direction (or directions) from which the main part of the user signal is received. This direction is used on downlink by choosing the weights $z1– zN$ so that the radiation pattern is a lobe (or lobes) directed toward the desired user. … In

> addition, it is possible to position zeros in the direction toward other users so that the interference suffered by these users is minimized…..

EX-1010, 11. See also EX-1010, FIG. 17.

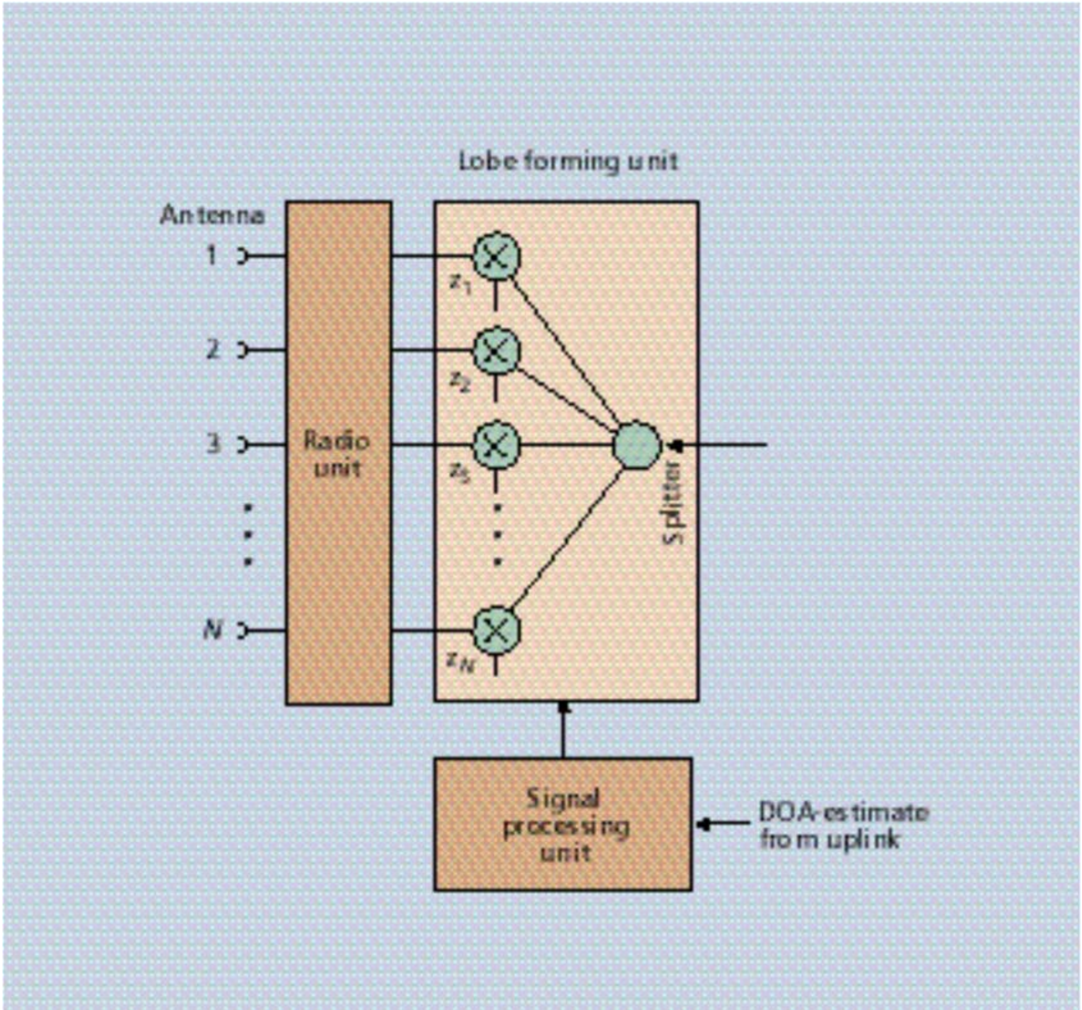
Thus, the prior art teaches this element.

d. <u>Claim 28</u>

> ***[28] The method as recited in claim 13, further comprising using at least one transmitting device transmit antenna operatively coupled to said transmitting device to transmit said modified forward path data signal over at least one forward transmission path to the receiving device.***

Wong, in combination with Minn and Lehne, discloses this limitation for the reasons discussed for limitation [1.2], [13], [15]. EX-1003, ¶¶506-512. As the Examiner noted, including an antenna to transmit a wireless signal is obvious and inherent in a reference discloses wireless communication from a BS (like Wong). EX-1002, 0072.

Lehne provides extensive details on the transmit antennas, including various forms of antenna arrays, at its base station. EX-1010 at 4, 5, 10-11 ("Transmitter" section). "The transmission part of the smart antenna will be schematically very similar to the reception part. An illustration is shown in Fig. 16." EX-1010, 10.



EX-1010, 11 ("Figure 16. Transmission part of a smart antenna."). *See also* EX-1010, 4-9 (describing antenna technology used for reverse and forward paths). EX-1003, ¶¶252-253.

Thus, the prior art discloses this element.

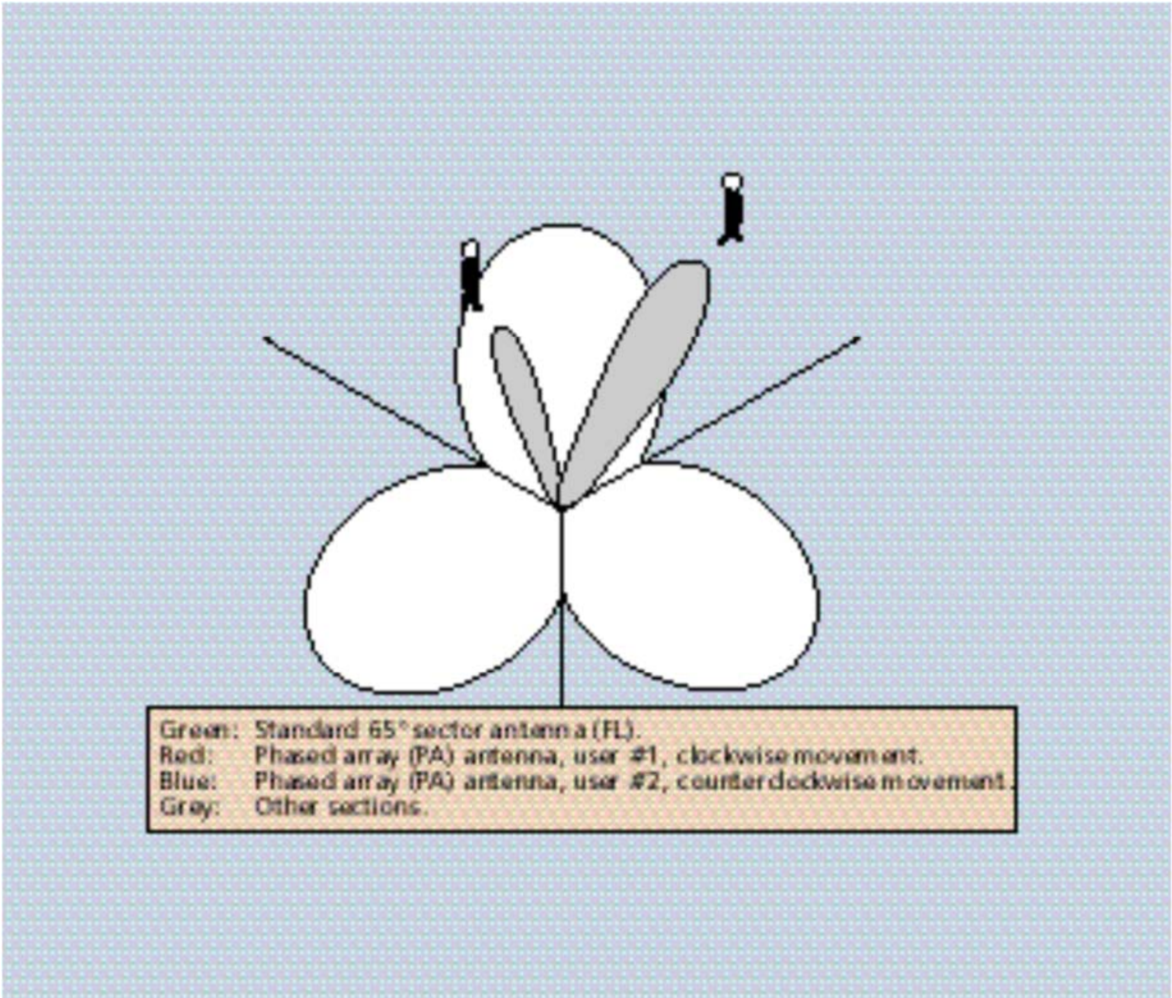
e. <u>Claim 32</u>

[32] The method as recited in claim 28, further comprising: setting at least one antenna pointing parameter associated with said at least one transmitting device transmit antenna based on said at least one forward path pre-equalization parameter.

Wong, in combination with Minn and Lehne, discloses this limitation for the reasons discussed for limitation [1.2], [13], [15], [21], [28]. EX-1003, ¶¶513-521. This claim is obvious for the reason stated by the Examiner during prosecution. EX-1002, 0075.

The '369 Patent does not recite any "antenna pointing parameter" but rather uses "antenna pointing" in the context of using a phased antenna array to direct transmission and reception. EX-1001, 5:8-15, 10:61-11:44.

Lehne teaches a similar concept including teaching a phased array to perform beamforming. For example, Lehne teaches beamforming and illustrates such beamforming in its Figure 1:



EX-1010, 3 ("FIGURE 1. Illustration of the difference between a traditional base station radiation pattern and a smart antenna base station."). *See also* EX-1010, FIG. 3 (showing different types of beams); FIG. 14 (different beams for different types of arrays).

As noted for claim 21, Lehne teaches using the "direction of arrival" to improve both the uplink reception and the downlink transmission. The information regarding the "uplink" is used to "point" the downlink transmission using, for example, beamforming:

> Thus optimum beamforming (i.e., AA) on downlink is difficult, and the technique most frequently suggested is the geometrical approach of estimating the direction-of-arrival (DoA). The assumption is directional reciprocity, i.e., the direction from which the signal arrived on the uplink is the direction in which the signal should be transmitted to reach the user on downlink. This assumption has been strengthened by recent experimental results [21]. **The strategy used by the base station is to estimate the DoA of the direction (or directions) from which the main part of the user signal is received. This direction is used on downlink by choosing the weights *z*1– *zN* so that the radiation pattern is a lobe (or lobes) directed toward the desired user.** This is similar to PA. In addition, it is possible to position zeros in the direction toward other users so that the interference suffered by these users is minimized.

EX-1010, 11. Lehne also uses the term "steer" to teach "pointing" and that:

> If the phased array approach (PA) is used, which consists of directing a maximum gain beam toward the strongest signal component, the direction-of-arrival ((DoA) is first estimated and then the weights are calculated as described in the previous section with uniform amplitude and phase in accordance with the desired steering angle.

EX-1010, 9. See also EX-1010 at 5 ("Electronically steerable antenna patterns…."); 7 ("FIGURE 9 Using the phase angle of each element to steer the lobe"); 8 ("it is desired to steer the main lobe of the antenna in a certain direction…."). Lehne teaches how to adjust the transmission weights to perform such steering/pointing. EX-1010, 7-10.

Thus, the prior art discloses this element. EX-1003, ¶¶518-521.

f. <u>Claim 33</u>

[33] The method as recited in claim 28, further comprising: setting at least one phased array antenna transmission directing parameter associated with said at least one transmitting device transmit antenna based on said at least one forward path pre-equalization parameter.

Wong, in combination with Minn and Lehne, discloses this limitation for the reasons discussed for limitation [1.2], [13], [15], [21], [28], [32]. EX-1003, ¶¶522-528. Furthermore, this claim is obvious for the reasons stated by the Examiner during prosecution. EX-1002, 0075.

Lehne teaches this transmission directing parameter in its discussion of the direction of arrival, pointing, and steering the antennas (both for reception and transmission) as detailed above in claims 21 and 32.

A POSITA would understand that Wong, alone or in view of Minn discloses "said at least one forward path pre-equalization parameter" as discussed above for claim 1. Furthermore, in view of Lehne such determination based upon at least the "received uplink transmissions" of Wong would also be applicable for "estimating the DoA" using at least a "direction of arrival (DoA) algorithm" on the "signal received from the user" such that the "received power is maximized" using "weights calculated on uplink" with respect to the "array elements" of the "smart antennas" disclosed in Lehne. EX-1003, ¶525. This includes specifically the

"Dynamically phased array (PA)." EX-1003, ¶525. Then because the "channel does not change during the period from uplink to downlink transmission," such "weights calculated on uplink" will be "optimal on downlink", thereby setting the "radiation pattern in the downlink direction" that is "Electronically steerable" to be the same as the optimum "direction of arrival (DoA)" on the uplink *(i.e.* "setting at least one phased array antenna transmission directing parameter associated with said at least one transmitting device transmit antenna") as determined by the calculation of the "magnitude of the channel gain at the base station" (*i.e.* "based on said at least one forward path pre-equalization parameter"). EX-1003, ¶525.

g. <u>Claim 35</u>

> ***[35] The method as recited in claim 28, further comprising: selecting said at least one transmitting device transmit antenna from a plurality of transmitting device transmit antennas that are each operatively coupled to said transmitting device.***

Wong, in combination with Minn and Lehne, discloses this limitation for the reasons discussed for limitation [1.2], [13], [15], [21], [28], [32]. EX-1003, ¶¶529-539. First, as the Examiner held during prosecution (without dispute from the applicant), "it would have been obvious to one skill in the art to select one antenna from a plurality of antenna to improve system flexibility." EX-1002, 0076. Moreover, because this claim recites "selecting <u>at least one</u>…" it is invalid over any reference that teaches using any number of the antennas (from one antenna up to all of the antennas). This claim merely adds that there are a

plurality of antennas. As noted above, Lehne teaches an antenna array with multiple antennas. See EX-1010, Fig. 16.

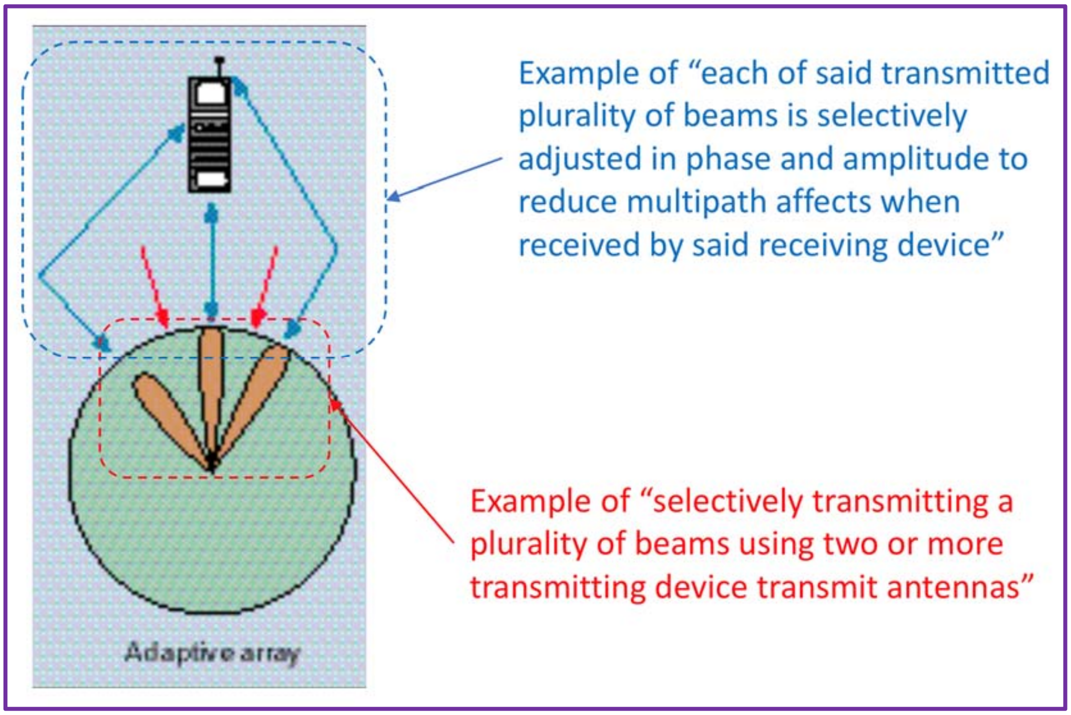
Moreover, if the claim requires a specific selection of antenna(s), Lehne discloses such a selection in its discussion of "switched lobe" or "switched beam" approaches. EX-1010, 4, 8-10, Figure 3. EX-1003, ¶¶534-539. Such an approach is "easier to implement in existing cell structures", uses a "switching function between separate directive antennas or predefined beams of an array" wherein a "setting that gives the best performance, usually in terms of received power, is chosen." EX-1010, 4. This approach "selects" one or more of the antenna array to create the "lobe" or "beam." EX-1003, ¶¶534-537, 478-491.

h. <u>Claim 36</u>

[36] The method as recited in claim 35, further comprising: selectively transmitting a plurality of beams using two or more transmitting device transmit antennas.

Wong, in combination with Minn and Lehne, discloses this limitation for the reasons discussed for limitation [1.2], [13], [15], [35]. EX-1003, ¶¶540-546. First, as the Examiner held during prosecution (without dispute from the applicant), "it would have been obvious to one skill in the art to selectively transmit a plurality of beam using at least two transmit antenna to improve signal detection." EX-1002, 0076. Lehne references beams also as "lobes" and teaches a "lobe forming unit" for both reception and transmission. EX-1010 at 10 (describing "lobe forming unit"); FIGS. 12, 15, 16.

Second, in addition to the analysis for clam 35 (which shows the elements in this claim), Lehne describes for the "Adaptive array (AA)" that with "space diversity techniques, the radiation pattern can be adapted to receive multipath signals which can be combined" as "illustrated in Fig. 3." EX-1010, 4.



EX-1010 at Figure 3 (excerpted). EX-1003, ¶¶542-543. The bi-directional blue arrows show multiple beams transmitting from the array.

Accordingly, a POSITA would understand that Lehne describes the "Adaptive array (AA)" approach as shown by excerpted and annotated Figure 3 as having a "radiation pattern in the downlink direction" that is "adapted" to have multiple "beams" (three such "beams" being depicted in Figure 3) that are transmitted across the multiple "antenna elements" in the "array" ("two or more

transmitting device transmit antennas") on which the "signal is divided" in "both phase and amplitude" ("selectively transmitting"). EX-1003, ¶¶542-546.

i. <u>Claim 37</u>

[37] The method as recited in claim 36, wherein each of said transmitted plurality of beams is selectively adjusted in phase and amplitude to reduce multipath affects when received by said receiving device.

Wong, in combination with Minn and Lehne, discloses this limitation for the reasons discussed for limitation [1.2], [13], [15],[36]. EX-1003, ¶¶547-556. First, as the Examiner held during prosecution (without dispute from the applicant), "it would have been obvious to one skill in the art to adjust the plurality of beams in amplitude and in phase so as to improve signal detection." EX-1002, 0076.

Lehne teaches that it "steers" its beams (also referenced as "lobes") to reduce multipath as a benefit: "***Reduced Multipath Propagation*** — By using a narrow antenna beam at the base station the multipath propagation can be somewhat reduced." EX-1010, 5. Lehne teaches that the lobes (beams) are adjusted in phase and amplitude to control the beams. EX-1010, 6 ("The technology is based on array antennas where <u>the radiation pattern is altered by adjusting the amplitude and relative phase on the different array elements</u>."). Lehne teaches the reason that such adjustments occur. "The total radiation pattern is given by the *element type*, the *relative positions* and the excitation (amplitude and phase)." EX-1010, 7.

Lehne discloses for the "transmission part of the smart antenna" that "The signal is split into N branches, which are weighted by the complex weights $z_1 - z_N$ in the lobe forming unit" and these "weights, which decide the radiation pattern in the downlink direction, are calculated by the signal processing unit." EX-1010, 10. A POSITA would understand this disclosure of "***complex weights***" to mean that each "***weight***" comprises a real and an imaginary component as a Cartesian coordinate representation of the polar coordinate combination of amplitude and phase. EX-1003, ¶¶549-550, 252.

Lehne also discloses that "[e]lectronically steerable antenna patterns are most often generated using array antennas" that are "consisting of a number of antenna elements on which the signal is divided or combined in both phase and amplitude." EX-1010, 6. EX-1003, ¶¶551, 245. "By using a narrow antenna beam at the base station the multipath propagation can be somewhat reduced." EX-1010, 5.

As shown in annotated / excerpted Figure 3 (above for claim 36), a POSITA would understand, that Lehne discloses multiple such "narrow antenna beam[s] at the base station" for the "radiation pattern in the downlink direction" that as "combined" when "received by said receiving device" (*i.e.*, the "user") cause such "multipath propagation" to be "reduced." EX-1003, ¶¶552, 542.

Accordingly, a POSITA would understand that Lehne describes the

"Adaptive array (AA)" approach as shown by excerpted and annotated Figure 3 as having a "radiation pattern in the downlink direction" that is "adapted" to have multiple "narrow antenna beams" (i.e., three such "beams" being depicted in Figure 3). These beams are transmitted across the multiple "antenna elements" in the "array" on which the "signal is divided" in "both phase and amplitude" when "weighted by the complex weights" (*i.e.*, "selectively adjusted in phase and amplitude") such that the effects of "multipath propagation" is "reduced" for the "user" *(i.e*, "to reduce multipath affects when received by said receiving device"). EX-1003, ¶¶553.

Thus, the prior art teaches this element. EX-1003, ¶¶554-556.

VIII. THE BOARD SHOULD NOT EXERCISE ITS DISCRETION AND DENY INSTITUTION

A. The Board Should Not Deny Institution Under 35 U.S.C. § 325(d)

The '369 Patent has not been previously challenged in an IPR. The Examiner did not consider any of the prior art used in the analysis above. Moreover, the primary reference (Wong) discloses the exact element that provided patentability during prosecution.

B. The Board Should Not Deny Institution Under 35 U.S.C. § 314(a)

The PTAB has discretion to deny institution under 35 U.S.C. § 314(a). Related to the Director's June 2022 interim guidance regarding application of the

Fintiv factors[5], (1) the Petition is particularly strong in the underlying merits, and (2) Petitioners will not pursue in the Related Litigation any ground raised in this IPR. Thus, under the Interim Guidance, the Board should not deny institution.

Nevertheless, the Board's decision in *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 (Dec. 1, 2020) instructs that a holistic view of the remaining *Fintiv* factors also weighs in favor of institution.

Factor 1 is neutral because no request for stay has been filed.

Under factor 2, the earliest scheduled trial date is March 3, 2025. A Final Written Decision is expected in the present matter in July of 2025. Considering the inherent uncertainties of litigation scheduling, this factor is neutral. Because much can change in four months, the current trial date does not support denial. See *Dish Network v. Broadband iTV*, IPR2020-01280, Paper 17 at 16 (PTAB Feb. 4, 2021) ("We cannot ignore the fact that the currently scheduled trial date is more than nine months away and much can change during this time").

Factor 3 heavily favors institution. The Markman hearing is scheduled for September 11, 2024 which is at least 2 months after the projected institution date.

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[5] Interim Procedure For Discretionary Denials In AIA Post Grant Proceedings With Parallel District Court Litigation, PTO Director's Memorandum (June 21, 2022).

Fact discovery closes on October 4, 2024, and expert discovery closes on November 18, 2024. Thus, the Related Litigation is in its early stages, and the investment in it has been minimal. The district court will not invest significant resources or issue substantive orders related to the challenged patent prior to the issuance of an institution decision. Moreover, Petitioners diligently prepared this Petition and filed well in advance of the statutory deadline, which weighs further against denying institution.

Under factor 4, there will not be complete overlap in the issues raised in the IPR and the Related Litigation and this favors institution. PO has asserted 88 claims from five patents in the Related Litigation – an amount that far exceeds the number of claims that the district court will allow to be presented at trial. See https://txed.uscourts.gov/?q=model-order-focusing-patent-claims-and-prior-art-reduce-costs. (Model Order limiting patentees to a "Final Election of Asserted Claims, which shall identify no more than <u>five asserted claims per patent</u> from among the ten previously identified claims and no more than a total of 16 claims"). Given that the patentee will likely be limited to only five claims from the '369 Patent (at most), it is highly unlikely the district court will be addressing the validity of all of the claims challenged by this Petition (more than 20 Challenged Claims). Petitioners stipulate that they will not pursue invalidity against the asserted claims in the district court using the specific combination of prior art

references set forth in the grounds presented in this Petition for purposes of establishing obviousness. *See Sand Revolution II LLC v. Continental Intermodal Group-Trucking LLC*, IPR2019-01393, Paper 24 at 11-12 (PTAB June 16, 2020) (holding a similar stipulation weighs against discretionary denial).

Under factor 5, Petitioners are Intervenors / Defendants in the Related Litigation. This factor is neutral as it is "far from an unusual circumstance that a petitioner in inter partes review and a defendant in a parallel district court proceeding are the same." *Sand*, No. IPR2019-01393, Paper 24, at 12-13. .

Under factor 6, other circumstances weigh in favor of institution. Here, the merits of the Petition are particularly strong. For example, Wong is directed at the same problem and proposes the same solution as the '369 Patent, and discloses identical architecture and the identical concepts disclosed in the '369 Patent, demonstrating that the Petition is particularly strong in the underlying merits. Moreover, as detailed above, except for the portions of the claim disclosed by Wong, the Examiner determined all of the claim elements to be in the prior art.

When viewed holistically, the timing of the present Petition is reasonable, there has been limited investment in the Related Litigation, and there is minimal overlap between the present IPR and the Related Litigation. Coupling these *Fintiv* considerations with the compelling evidence of unpatentability presented in the

Petition, the efficiency and integrity of the IPR process is best served by instituting review.

IX. Mandatory Notices Under 37 C.F.R. §42.8

A. Real Party-in-Interest (37 C.F.R. § 42.8(b)(1))

The real party-in-interest in this Petition is Ericsson Inc., and corporate parent Telefonaktiebolaget LM Ericsson, and Nokia of America Corporation. No other parties have directed, funded, or controlled the filing of this IPR, and this IPR was not filed at the behest of any other party.

To avoid additional issues associated with real parties in interest, Petitioners likewise identify T-Mobile USA, Inc., AT&T Services Inc., AT&T Mobility LLC, AT&T Corporation, and Cellco Partnership d/b/a Verizon Wireless because Petitioners' products provided to these entities have been accused of infringement in the Related Matters identified below.

B. Related Matters (37 C.F.R. § 42.8(b)(2))

1. Judicial Matters

As of the filing date of this Petition and to the best knowledge of Petitioners, the '369 Patent is involved in the following litigations:

- *XR Communications LLC v. Verizon Communications, Inc. et al.,* U.S.D.C. EDTX Case No. 2:23-cv-00203-JRG-RSP;
- *XR Communications LLC v. T-Mobile USA, Inc.,* U.S.D.C. EDTX Case No. 2:23-cv-00204-JRG-RSP;

- *XR Communications LLC v. AT&T SERVICES INC.; AT&T MOBILITY LLC; AND AT&T CORP.*, U.S.D.C. EDTX Case No. 2:23-cv-00202-JRG-RSP.

These are referenced collectively herein as the "Related Litigation(s)."

2. Administrative Matters:

As of the filing date of this Petition and to the best knowledge of Petitioners, the '369 Patent was not subject to any administrative matters.

3. Related Patents

Petitioners are unaware of any related patents.

C. Lead/Back-up Counsel (37 C.F.R. § 42.8(b)(3)):

Lead Counsel: Patrick D. McPherson, USPTO Reg. No. 46,255 DUANE MORRIS LLP, 901 New York Ave. NW Suite 700 East, Washington, D.C. 20001 P: (202) 776-5214; PDMcPherson@duanemorris.com
Back-Up Counsel: Kevin Anderson, USPTO Reg. No. 43,471 DUANE MORRIS LLP, 901 New York Ave. NW Suite 700 East, Washington, D.C. 20001 P: (202) 776-5213; KPAnderson@duanemorris.com

D. Notice of Service Information (37 C.F.R. § 42.8(b)(4)):

Please direct all correspondence to lead and back-up counsel at the above addresses. Petitioners consent to electronic service at the email addresses above.

X. CONCLUSION

Petitioners requests the Board institute *inter partes* review and cancel all Challenged Claims.

Respectfully submitted,

DUANE MORRIS LLP

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Dated: January 5, 2024

CERTIFICATION OF SERVICE ON PATENT OWNER

Pursuant to 37 C.F.R. §§ 42.6(e), 42.8(b)(4) and 42.105, the undersigned certifies that on the 5th of January, 2024, a complete and entire copy of this Petition for *Inter Partes* Review of U.S. Patent No. 7,177,369 and all supporting exhibits were served hard-copy via delivery service (UPS / FedEx), to the correspondence address of record for the '369 Patent:

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ATTORNEY FOR PETITIONERS

CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24 *et seq*., the undersigned certifies that this document complies with the type-volume limitations. This document contains 13,546 words as calculated by the "Word Count" feature of Microsoft Word 2010, the word processing program used to create it. In addition, there were 319 words added to the annotated Figures herein as counted manually.

Dated: January 5, 2024

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